COMPARATIVE ANALYSIS OF EFFECT OF SELECTED BIOFERTILIZERS ON THE GROWTH OF TOMATO PLANT

DISSERTATION SUBMITTED IN PARTIAL FULFILLMENT OF THE

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By

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CERTIFICATE

This is to certify that the dissertation entitled **"Comparative analysis of effect of selected biofertilizers on the growth of tomato plant"** is an authentic work carried out by Ms. Gratia Mary (AB20B0T005) under my supervision guidance in the Department of Botany, St. Teresa's College (Autonomous), Ernakulam, in the partial fulfilment of the requirements for the award of the Degree of Bachelor of Science in Botany. I further certify that no part of this work in this project has been submitted for the award of any degree or diploma.

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ABSTRACT

As the world population is high, the increasing demands for food increased. So food production must also being increased. The objective of the present study is to investigate the growth of *Solanum lycopersicum.* The difference in the growth was tested between groups with or without treatment using organic fertilizer. The growth pattern of four plants with four control plants was analysed. The eight plants exhibited different growth with and without organic fertilizer. This result achieves the aim of the study of fast growing tomato plant.

INTRODUCTION

A tomato is a nutrient-dense superfood that offers benefit to a range of bodily systems. Its nutritional content supports healthful skin, weight loss, and heart health.The tomato (*Solanum lycopersicum*) is a fruit from the nightshade family native to South America.They are a great source of vitamin C, potassium, folate, and vitamin K. Due to the restrictions on organic foods, not many fertilizers or growth promoters are available for organic tomatoes. Application of stimulators may contribute to enhanced growth, yield, and resistance against agricultural and horticultural plant pathogens, as well as the positive impact of content and activity of certain bioactive compounds. The quality of a vegetable can be characterized by features such as appearance, texture, safety, flavour and nutritional value. The growing management of tomatoes, however, is highly influenced by pulverization of pesticides, so, there is the requirement for improving tomato production, and give consumers superior flavour and quality to reach their expectations. To produce organic food, it is necessary to use inputs and methods that improve the ecological equilibrium of natural systems. This happens because organic vegetable is grown without pesticides, herbicides, highly soluble fertilizers and genetically modified organisms. The value of the organic product is not only in the product itself, but also in its production process. Several researches show that the demand of organic agriculture has increased, because this kind of product is identified by the consumers as a healthy product. The main motive for conducting this project experiment is to help people to cultivate organic tomatoes which would grow at a higher rate with the help of organic solutions which can be made at home itself. The United States, China, Mexico and Italy are the countries with the largest organic vegetable areas, all of them with more than 20 thousand hectares each.The solutions we selected for this experiment are based on the aspects like availability, free of cost, reusing of byproduct or waste material, eco-friendly beneficial for plant growth, etc. Despite the high growth, the organic farming comprises a small area of the total acreage in the world, probably due to the need for more information about the agronomic development of crops under organic management, justifying the importance of a larger effort in research for new agricultural practices.

The tomato crop has a great importance in the world, and its production, in 2013, reached 163.9 million tons and average yield of 34.7 tons per hectare. The tomato is classified as a functional food, for having good levels of vitamins, minerals, and especially lycopene, a carotenoid pigment that provides red colour and has antioxidant qualities.

OBJECTIVES

- To study the effect of ash solution on the growth of tomato plant.
- To study the effect of onion peel extract on the growth of tomato plant.
- To compare the effect of both bio fertilizers on the growth and development of tomato plants.

LITERATURE REVIEW

Organic fertilizers are generally thought to be an effective way to sustain soil fertility and plant growth. Onion peel solution and Ash solution are said to have many plant growth elements in them.The solutions we selected for this experiment are based on the aspects like availability, free of cost, reusing of byproduct or waste material, eco-friendly beneficial for plant growth, etc.Onion peel is rich in potassium, calcium and iron, which can help the plants grow strong.Ash solution contains the presence of calcium carbonate & potassium plays a bigger role in ash which helped for the faster growth of tomato plants. Organic liquid fertilizer not only increases the growth medium of crops, but also accelerates the maturation and nutrient quality of the crops.

Organic fertilizers are naturally available mineral sources that contain moderate amount of plant essential nutrients. They are capable of mitigating problems associated with synthetic fertilizers. They reduce the necessity of repeated application of synthetic fertilizers to maintain soil fertility. They gradually release nutrients into the soil solution and maintain nutrient balance for healthy growth of crop plants. They also act as an effective energy source of soil microbes which in turn improve soil structure and crop growth. Organic fertilizers are generally thought to be slow releasing fertilizers and they contain many trace elements. They are safer alternatives to chemical fertilizers. However, the improper use of organic fertilizers leads to over fertilization or nutrient deficiency in the soil. Hence, controlled release of organic fertilizers is an effective and advanced way to overcome these impacts and maintain sustainable agriculture

Ash or ashes are the solid remnants of fires. Specifically, ash refers to all non-aqueous, non-gaseous residues that remain after something burns. In analytical chemistry, to analyse the mineral and metal content of chemical samples, ash is the non-gaseous, non-liquid residue after complete combustion.

Ashes as the end product of incomplete combustion are mostly mineral, but usually still contain an amount of combustible organic or other oxidizable residues. The best-known type of ash is wood ash, as a product of wood combustion in campfires, fireplaces, etc. The darker the wood ashes, the higher the content of remaining charcoal from incomplete combustion. The ashes are of different types. Some ashes contain natural compounds that make soil fertile. Others have chemical compounds that can be toxic but may break up in soil from chemical changes and microorganism activity.

Wood ash is commonly disposed of in landfills, but with rising disposal costs, ecologically friendly alternatives, such as serving as compost for agricultural and forestry applications, are becoming more popular. Because wood ash has a high char content, it can be used as an odor control agent, especially in composting operations.Wood ash has a very long history of being used in ceramic glazes, particularly in the Chinese, Japanese and Korean traditions, though now used by many craft potters. It acts as a flux, reducing the melting point of the glaze.

According to one research on the average the burning of wood results in about 6–10% ashes.The residue ash of 0.43 and 1.82 percent of the original mass of burned wood (dry basis) is produced for certain woods if it is pyrolized until all volatiles disappear and it is burned at 350 °C (662 °F) for 8 hours.Also the conditions of the combustion affect the composition and amount of the residue ash, thus higher temperature will reduce the ash yield. Wood ash can be used as a fertilizer used to enrich agricultural soil nutrition. In this role, wood ash serves as a source of potassium and calcium carbonate, the latter acting as a liming agent to neutralize acidic soils.Wood ash can also be used as an amendment for organic hydroponic solutions, generally replacing inorganic compounds containing calcium, potassium, magnesium and phosphorus.Containing these kinds of nutritional elements will help your plant to grow faster with improved quality. In correspondence to that, it will enable you to do a Do-It-Yourself (DIY) wood ash in a jar with water and transfer it to the pot, so that plants can absorb its nutrients.

The onion has been grown and selectively bred in cultivation for at least 7,000 years. It is a biennial plant but is usually grown as an annual. Modern varieties typically grow to a height of 15 to 45 cm (6 to 18 in). The leaves are yellowish- to bluish green and grow alternately in a flattened, fan-shaped swathe. They are fleshy, hollow, and cylindrical, with one flattened side. As the onion matures, food reserves accumulate in the leaf bases, and the bulb of the onion swells.Onion peel is rich in potassium, calcium and iron, which can help the plants grow strong.Nitrogen is one of the most important nutrients for onion plant growth and development. A typical onion crop will use about 150-200 pounds of actual nitrogen per acre during the growing season, with a majority of the nitrogen taken up after the plant has started to bulb. Sulphur is recommended as basal dose at the time of transplanting. Application of 15 kg sulphur/ha is sufficient for growing onion crops in soils having sulphur level above 25 kg/ha while 30 kg sulphur/ha is needed for soils having sulphur level below 25 kg/ha for optimum production of onion. . These essential nutrients could be derived from fertilization. Fertilization, both organic and inorganic, is an important agricultural practice to increase crop yields,

improve plant growth and development and maintain soil fertility by supplying nutrients to the plants . The high fertilizer cost reduces the net returns and profits to the farmer. Also, the uncontrolled use of inorganic fertilizers leads to soil quality and water degradation through surface runoff and leaching. A better nutrient management strategy will be beneficial to farmers saving the high cost imposed on fertilizer and enable the production in a sustainable manner (Mokaya,).

Organic fertilizers can be used in place of chemical fertilizers because they have been found to improve soil fertility, water holding capacity, and structure, while chemical fertilizers may degrade the soil's physical properties and fertility. onion skins are great way to add nutrients to your compost pile.Onion skin and peels have antioxidant and antimicrobial properties and contain many useful substances like sulphur, quercetin, Potassium, phosphorus, zinc, iron, iodine, vitamins, pectins, saponins, flavonoids and so on. This experiment was conducted to note the change and rate of growth happening to a tomato plant compared to that of using ash solution from the early sapling stage to its flowering stage.

Tomato plant was used for the study since, Tomato is widely used as a model crop for fruit development but also for diverse physiological, cellular, biochemical, molecular, and genetic studies. It can be easily grown in greenhouses or growth chambers. Plants grow, flower, and develop fruits well at daily light lengths between 8 and 16 h. The required daily light integral of an experiment depends on growth stage and temperature investigated. Temperature must be 10–35°C, relative humidity 30–90%.

Cultivated tomato belong to the *Solanaceae* family and the genus Solanum. They are not only the most popular vegetable crop but also the most cultivated vegetable worldwide (4.7 Million ha). Moreover, tomato is one of the most studied fleshy fruits because it is easy to grow, often used to explore its characteristics, or used as a model plant makes the use of tomato as an experimental plant even more promising.

MATERIALS AND METHODS

The first step was to choose the plant type. The selected plants belong to the Solanaceae family- *Solanum lycopersicum*. These were selected due to their easy availability and easy germination. They were collected from a nursery in Aroor, Ernakulam. The seeds were examined to see whether there are diseased or malformed ones. Healthy seeds were separated out from the damaged ones for further experimental analysis.

The materials used for creating needed growth media are the following:

1. Grow bags
2. Soil
3. Tap water
4. Onion peel
5. Ash residue solution
6. Containers
7. Water can

The seeds were planted in two bags initially spaced at 10-15 cm distance. Seeds are sown at a depth of 2-3 cm and covered with fine layer of soil followed by light watering by water can. The beds were then covered with dry grass to maintain required temperature and moisture. The watering was done by water can as per the need till germination is completed. The covered dry grass was removed immediately after germination is complete. The seedlings with 5-6 true leaves were transplanted to the grow bags. Light irrigation was given 3-4 days after transplanting.

Preparation of Solutions:

1. Onion peel solution-

   Add the outer dry skin of onion to one litre of water. After 3-4 days, strain the water and dilute this solution with another litre of water. Then, use this solution to water your plants. Onion peel is rich in potassium, calcium and iron, which can help the plants grow strong.

2. Ash residue solution-

The wood ash obtained after the burning of hard wood was collected and soaked for about 2 to 3 days in one litre of water.Ash is also a good source of potassium, phosphorus, and magnesium.. In addition to these macro-nutrients, wood ash is a good source of many micronutrients needed in trace amounts for adequate plant growth.

The two prepared solutions were applied to the two tomato plants with a gap of 8-10 days. The height, number of leaves and branches, first flowered plant were noted. The average height was calculated for growth analysis. The photographs of the plants were also taken each 10 days for future references.

OBSERVATION AND RESULTS

The comparative analysis of growth pattern of the two solution applied tomato plants with two control plants for 60 days. After two months, the experiment was concluded and the data was tabulated.

Plants grown with Ash solution

In *Solanum lycopersicum,* the average height of the plant was 40cm on the 20th day, which increased to 70cm on 60th day. In the control plant, the average height of the plant on 20th day was 15cm, which increased to 50 cm. The solution applied plant shows progressive increase in height. More number of leaves was formed in solution applied plant.

Plants grown with Onion peel solution.

In *Solanum lycopersicum,* the average height of the plant was 50cm on the 20th day, which increased to 110cm on 60th day. In the control plant, the average height of the plant on 20th day was 25cm, which increased to 65cm. The solution applied plant shows progressive increase in height. In the case of onion peel solution, more number of leaves was formed in the solution used plant.

Growth pattern of Ash solution applied plant and control plant-

TABLE 1: Height of the plants after treating with ash solution

Days of growth	Height of plant (cm)
20 days	40cm
30 days	42cm
40 days	55cm
50 days	68cm
60 days	70cm

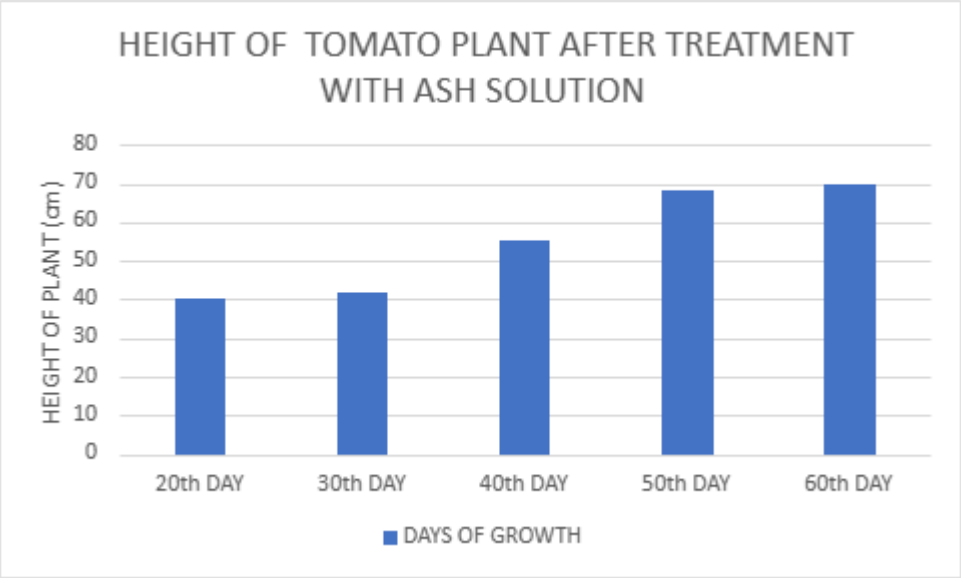

TABLE 2: Height of Control Plant

Days of growth	Height of control plant (cm)
20 days	15cm
30 days	20cm
40 days	31cm
50 days	42cm
60 days	50cm

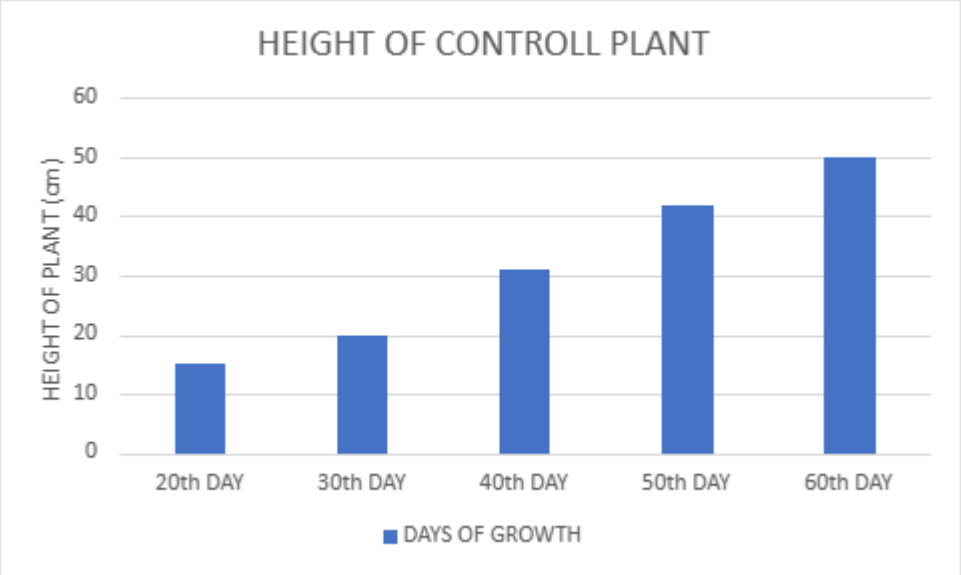

TABLE 3: Number of Leaves and Branches

Days of growth	Ash solution		Control plant	
	No. of leaves	No. of branches	No. of leaves	No. of branches
20 days	40	0	24	0
30 days	50	0	33	0
40 days	69	1	40	0
50 days	83	2	53	0
60 days	98	3	60	1

Growth pattern of Onion peel solution applied plant and control plant-

TABLE 4: Height of the plant after treatment with onion peel extract.

Days of growth	Height of plant (cm)
20 days	50cm
30 days	73cm
40 days	85cm
50 days	90cm
60 days	110cm

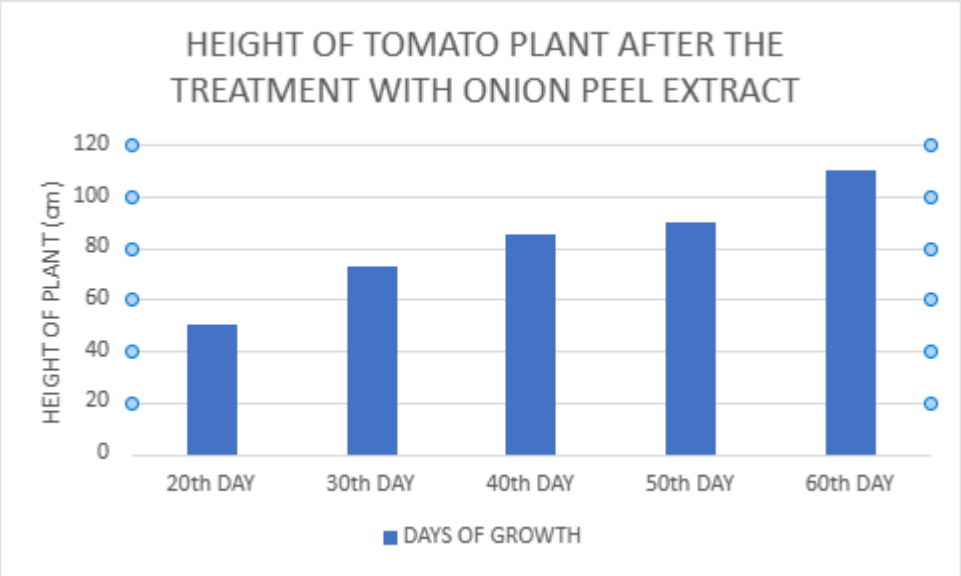

TABLE 5: HEIGHT OF CONTROLL PLANT

Days of growth	Height of controll plant (cm)
20 days	25cm
30 days	37m
40 days	47cm
50 days	59cm
60 days	65cm

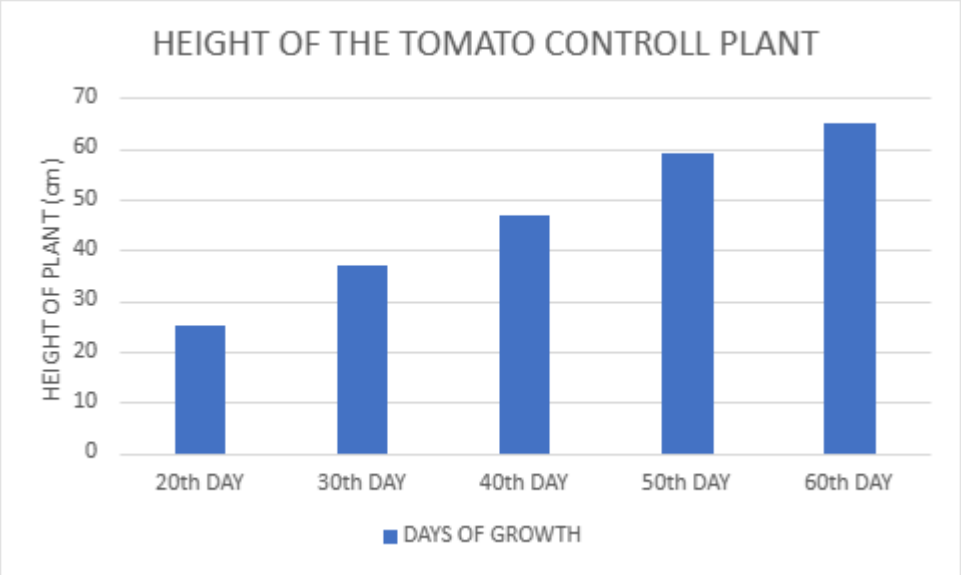

TABLE 6: Number of Leaves and Branches

Days of growth	Onion peel solution applied plant		Control plant	
	No. of leaves	No. of branches	No. of leaves	No. of branches
20 days	55	0	35	0
30 days	70	1	40	0
40 days	85	2	50	0
50 days	100	2	60	1
60 days	110	4	70	2

PHOTOGRAPHS

DISCUSSION

In this work we have made a comparative study between eight tomato plants with and without applying organic fertilizers. This study was meant to show that using which medium of organic fertilizer the tomato plant grow easily for cultivation without using chemical fertilizers. Here we had used Onion peel and Ash residue for preparing organic fertilizers. Solution applied tomato plants showed faster rate of growth when compared to control plants.

Plant growth parameters observed in the study consisted of plant height, number of leaves, branches and the flowering stage. The observations showed that the treatment using all the four solutions significantly affected the all plant growth.

The outer dry skin of onion (about a handful) to one litre of water. After 3-4 days, strain the water and dilute this solution with another litre of water. Then, use this solution to water your plants. Onion peel is rich in potassium, calcium and iron, which can help the plants grow strong. Potassium rich onion peels are excellent for plants like tomatoes. It also contains calcium, which prevents blossom end rot in tomatoes. Ash residues are used, which is also an excellent organic fertilizer. They release nitrogen naturally which helps balance out any carbon rich materials that may already be present. They are also rich in potassium and phosphorous.

Potassium maintains the ionic balance and water status within the plant. It is involved in the production and transport of sugars in the plant, enzyme activation, and synthesis of proteins. Potassium in tomatoes is also required for pigment synthesis, notably lycopene. High levels of potassium provide high yields in tomato crops. Calcium is a key component of cells holding the structure of cell walls and stabilizing cell membranes. Calcium enhances pollen germination; regulates some enzyme systems; and influences the growth and health of cells and conductive tissues. It is required for growth and yield and promotes the earliness of fruit development. The small amounts of calcium found in fruit are essential for the production of good quality tomatoes. Iron is required for nitrate and sulphate reduction and is associated with chlorophyll formation and photosynthesis. Manganese is an important micronutrient for plant growth and development and sustains metabolic roles within different plant cell compartments. Tomatoes *(Solanum lycopersicum*) are heavy nutrient feeding crops and require high amounts of nitrogen to maximize fruit production Magnesium is required for many processes including transfer of energy and protein synthesis. With 20-25 % of the plant's total magnesium localized in the chloroplasts, it is particularly important for chlorophyll production.

Tomato contains many health promoting compounds and are easily integrated as a nutritious part of a balanced diet (Marti et al., 2016). In addition to consuming the fresh fruits, consumers use tomatoes in processed products such as soups, juices, and sauces (Krauss et al., 2006; Li et al., 2018b). The nutritional importance of tomatoes is largely explained by their various health-promoting compounds, including vitamins, carotenoids, and phenolic compounds (Raiola et al., 2014; Liu et al., 2016; Marti et al., 2016; Li et al., 2018b).

Tomato has been recently gaining attention in relation to the prevention of some human diseases. This interest is due to the presence of carotenoids and particularly lycopene, which is an unsaturated alkali compound, appears to be an active compound in the prevention of cancer, cardiovascular risk and in slowing down cellular aging (Gerster, 1997; Di Cesare et al., 2012; Abdel-Monaim, 2012). Lycopene is found in fresh, red-ripe tomatoes as all-trans (79–91%) and cis- (9–21%) isomers (Shi et al., 1999; Boileau et al., 2002; Abdel-Fattah and Al-Amri, 2012).

In the case of this experiment, organic fertilizer was used as an alternative to the chemical fertilizer. When organic fertilizer was used, it resulted in faster growth rate. The purpose of this study is to have a healthier and cheaper alternative fertilizer for tomato plant. The study aims to determine the function of the organic fertilizers that was prepared from easily available sources in tomato plant for fast growth than normal conditions.

CONCLUSION

The demand for food is increasing all over the world due to the needs of the growing population. So the demand for food production is also increasing simultaneously. According to the data collected, the four plants in which the solution was applied show faster rate of growth when compared to control plants.

Among the two different growth media, onion peel solution was a good growth media with acceptable high amount of nutrients, including potassium, phosphorous, magnesium and calcium all of which are needed for good plant growth. It provides support to fast growth of the seedlings due to availability of better nutrition with water in root zone of seedlings. Therefore, the media of onion peel solution was more suitable than tap water because of the better physical properties and enhanced nutrient level. Results revealed significant differences in growth parameters among the two growing media when compared to control plants. The maximum growth parameters say, plant height was observed at plants grown with onion peel. Hence, onion peel solution was found as suitable growth media for growing of tomato seedling than tap water. The increasing demands of the developing world could be met only by new method of cultivation.

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