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RESEARCH **P**APER

Effect of vegetable and fruit waste on seed germination and growth of *Solanum lycopersicum*

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The study was aimed to determine the effect of vegetable and fruit waste extract on seed germination and growth of *Solanum lycopersicum*. The domestic vegetable and fruit waste was used as both extract and decoction at different dilutions to analyze its effect on seed germination, leaf emergence, growth and plant biomass. Effect of different concentrations of waste extract and decoction was compared to that of distilled water (control). The results revealed that all the concentrations of extract/decoction promoted seed germination, also contributed to seedling height, plant growth and biomass accumulation. However, an increase in dilution ratios from 1:5 to 1:8 had a significant effect on germination and growth of tomato plants. This suggests that domestic waste, which is one of the major causes of environmental pollution, can be used as an alternative to synthetic plant growth nutrients.

Key words : Domestic waste, Seed germination, Tomato

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INTRODUCTION

Waste generation and its subsequent accumulation by increase in human population is one of the major problems confronting future generations. Solid waste results from various sources including food, animal, hazardous, industrial, medical, mineral wastes, etc. Urban solid waste includes household garbage, construction and demolition debris, sanitation residues, trade, industrial refuse and biomedical solid waste (CPCB, 2000). India produces 300 to 400g of solid waste per person per day in town. Clearance of such large mass of solid waste generated daily is a major concern of cities, which could lead to a serious situation due to the toxicity and unavailability of dumping grounds (Vilas, 2015). At the same time the domestic waste can contain many reusable substances of high value, depending on there being an adequate technology to convert this residual matter into commercial products either as raw material for secondary processes as operating supplies or as ingredients of new products.Numerous valuable substances in food production are suitable for separation and recycling at the end of their life cycle, even though present separation and recycling processes are not absolutely cost efficient (Laufenberg *et al.*, 2003). The main goal of a clean production process is to upgrade vegetable waste for the production of bio fertilizer and to convert the vegetable waste to exclusive commercial products. According to the survey conducted by United Nations Development Programme, of 151 mayors of cities around the world, the second most serious problem that city dwellers face (after unemployment) is insufficient solid waste disposal (UNDP, 1998). It is a well known fact that improper disposal of such huge wastes poses a major threat to the

environment, high risks to human health and the effect can be devastating in nearby future. Most of these wastes like agriculture wastes are biodegradable and can be converted into valuable resources that reduce their negative impacts. However, waste collected from homes may be recycled and used as a potential resource, which is the main objective of this study. The use of non-chemical fertilizers and pesticides is one of the common practices that have been introduced with alternative agricultural systems, which includes the use of biofertilizers (Kanimozhi and Panneerselvam, 2010).

It is evident that the household waste discarded daily also has a potential source of carbon, nitrogen, vitamins and amino acids which generally induce plant growth. Therefore, the present work was undertaken to evaluate the effects of various domestic vegetable and fruit waste on the germination and growth of tomato plants.

RESEARCH METHODOLOGY

The domestic waste (peels) obtained from vegetables like potato (*Solanum tuberosum* L.), pomegranate (*Punica granatum*), outer leaves of cabbage (*Brassica oleracea*), root waste of coriander (*Coriandrum sativum*) were used to prepare extract and decoction samples. The vegetable and fruits used in the present study were selected based upon their (a) availability throughout the year; (b) source of plant growth promoting ingredients like: carbon, nitrogen, mineral and amino acids and (c) absence of toxic or harmful components.

The collected vegetable and fruit waste was washed thoroughly with running tap water, distilled water, air dried for an hour to weigh them as follows-peels of potato peel (45 g), pomegranate (10g), cabbage leaves (25g) and roots of coriander (5 g), which were finely chopped and used to prepare decoction as well as crude extract samples.

The decoction was made by crushing the waste material using sterile mortar and pestle, followed by heating at 70^0C for 15 minutes, which was filtered through muslin cloth. The filtrate was centrifuged at 12000 rpm for 5 minutes to precipitate any unwanted particles. The supernatant was gently aspirated (up to 60ml) that was agitated using a shaker for 24hrs. This preparation was preserved at 4°C and used as a prospective medium for the seed germination studies. On the other hand the crude extract was prepared by grinding the waste material in a mixer grinder with 25ml distilled water. The mixture was filtered using a muslin cloth and the filtrate was incubated in a shaker for 24hrs. The extract obtained (about 70ml) was preserved at 4^0C for future use and to avoid any contamination.

The treatments designed from both decoction and crude extract fall in a range of dilution ratios from 1:1 (1 ml decoction/ extract + 1 ml distilled water) to 1:8 (1 ml decoction/ extract + 8 ml distilled water), respectively. The different dilutions ratios were used to assess their suitability and identify a best dilution that promotes significant seed germination and plant growth. The whole experiment was setup in a culture room with optimum conditions such as incubation temperature of 25 ± 2^0C, a light intensity of 2000 lux at 12 h photoperiod and a relative humidity of 80 per cent throughout the experiment. The seeds of tomato were thoroughly washed in running tap water for 2hrs and surface sterilized with a 0.5-2 per cent (v/v) sodium hypochlorite solution. Further, they were finally rinsed thrice with sterile distilled water and introduced for an overnight incubation in the respective dilution against a control which was distilled water. Five tomato seeds were sown in Petri plates with evenly spread cotton and treated by their respective decoction and extract dilutions at subsequent time intervals. The assessments including rate of germination, appearance of leaf and shoot length were carried out after 144hrs (6 days) and 168 hrs (7 days). While the other parameters like root length, wet weight and dry weight were recorded after 7 days. The dry weight of seedlings was taken after keeping them in hot air oven at 80^0C for 24 hours.

RESEARCH FINDINGS AND ANALYSIS

The results obtained in the present study on *Solanum lycopersicum* were analyzed and compared for determining different parameters including germination rate, leaf emergence, average length of whole plant, average fresh and dry weight of whole plant in response to decoction and crude extract. It was observed that the roots of tomato inoculated in waste extract were thicker and stronger compared to control.

The decoction treatment (ratio) from 1:1 to 1:4 showed 60 per cent germination and the dilution ratio from 1:5 to 1:8 showed 100 per cent germination along with the maximum plumule length of 3.5 cm, while the control showed only 40 per cent germination with no leaves appeared after 144hrs (Table 1). Interestingly,

leaves were emerged much earlier in all the treated plants in comparison to control (Fig. 1-2). The observations recorded at 168 hrs showed a maximum increase in plumule length of 4.2 cm for 1:8 decoction treated plants.

The effect of vegetable and fruit waste on plant growth was consistent with the crude extract treatment.

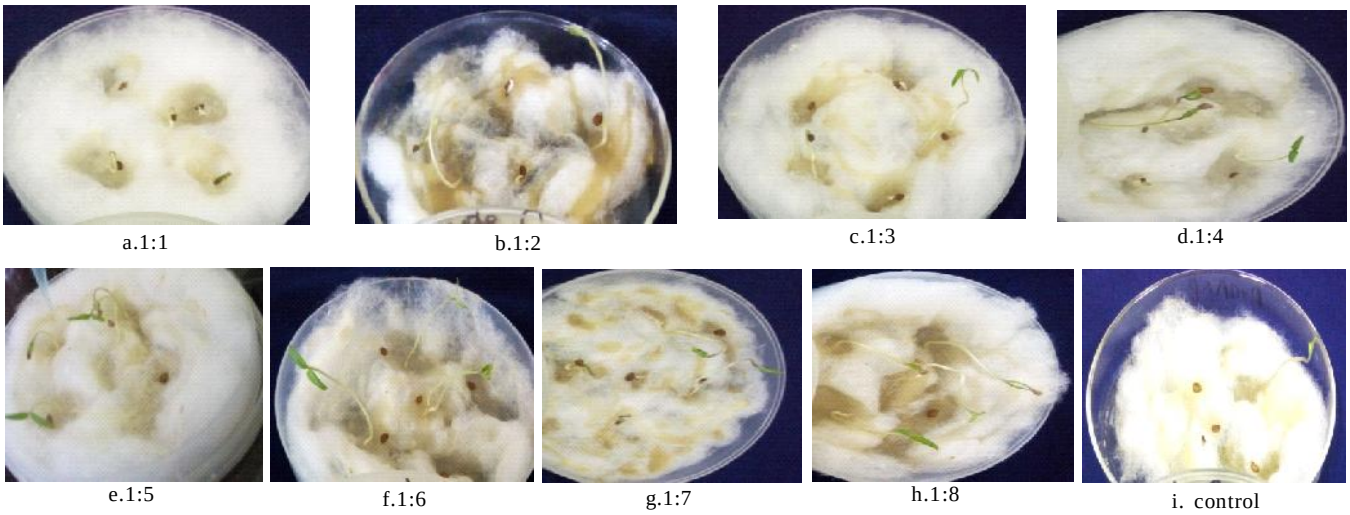

Fig. 1: Growth pattern of tomato plants at different dilutions of (a-h) decoction treatment and (i) control

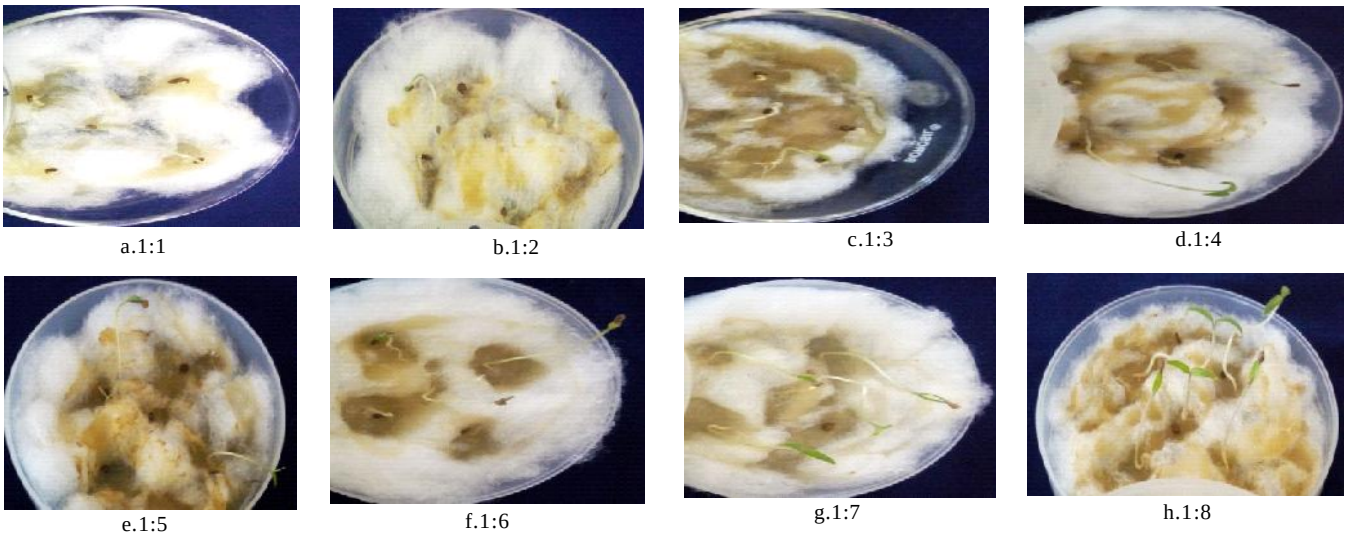

Fig. 2: Different growth pattern of tomato plants in different dilutions of crude extract treatment

Table 1: Growth of tomato at different dilutions of decoction media

Time period	Parameters	Control	Treatments (sample dilution)							
			1:1	1:2	1:3	1:4	1:5	1:6	1:7	1:8
144 hrs.	Number of seeds germinated	2	3	3	3	4	5	5	5	5
	Appearance of leaf	-	+	+	+	+	+	+	+	+
	Length of plumule (cm)	1	2.2	2.5	2.7	2.8	3	3.1	3.3	3.5
168 hrs.	Number of germinated seeds	3	4	4	4	4	5	5	5	5
	Appearance of leaf	+	+	+	+	+	+	+	+	+
	Length of plumule (cm)	1.5	3.3	3.5	3.6	3.6	3.7	3.8	4	4.2

+ presence of leaves; - absence of leaves

Table 2: Growth of tomato at different dilutions of crude extract

Time period	Parameters	Control	Treatments (sample dilution)							
			1:1	1:2	1:3	1:4	1:5	1:6	1:7	1:8
144 hrs.	Number of seeds germinated	2	4	4	4	4	5	5	5	5
	Appearance of leaf	-	+	+	+	+	+	+	+	+
	Length of plumule (cm)	1.2	2.1	2.3	2.7	3	3.2	3.5	3.7	3.8
168 hrs.	Number of germinated seeds	3	4	4	4	4	5	5	5	5
	Appearance of leaf	+	+	+	+	+	+	+	+	+
	Length of plumule (cm)	1.6	2.5	2.5	3	3.5	3.7	4	4.2	4.5

+ presence of leaves; - absence of leaves

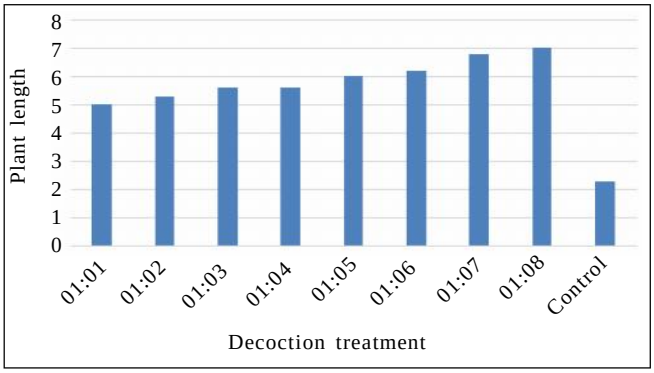

Fig. 3: Average length of tomato plants treated with decoction

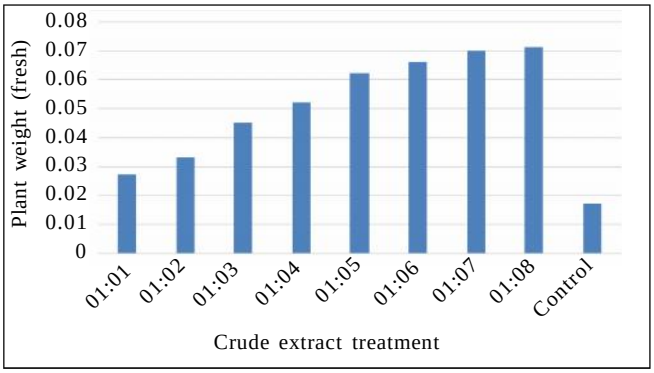

Fig. 6: Average fresh weight of tomato plants treated with crude extract

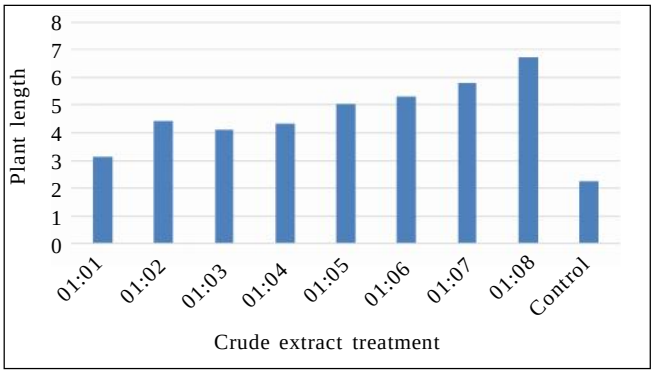

Fig. 4: Average length of tomato plants treated with crude extract

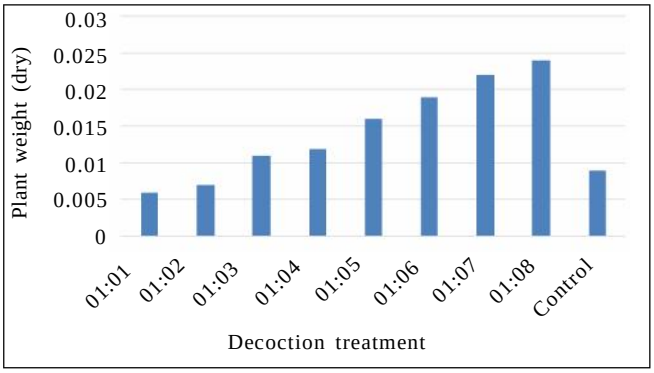

Fig. 7: Average dry weight of tomato plants treated with decoction

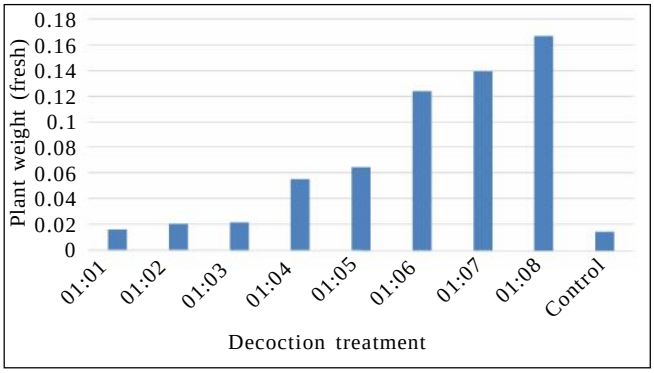

Fig. 5: Average fresh weight of tomato plants treated with decoction

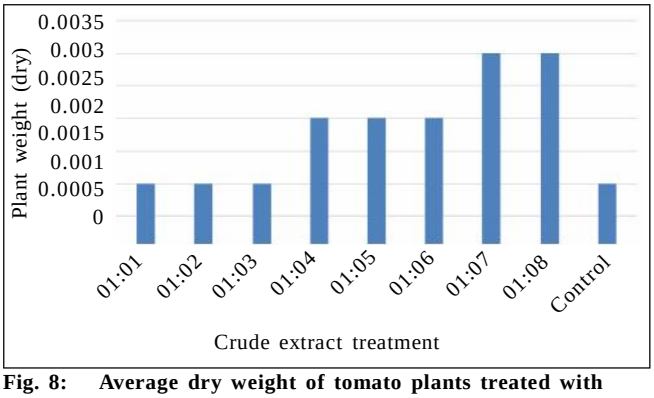

Fig. 8: Average dry weight of tomato plants treated with crude extract

The crude extract supported 80- 100 per cent germination, early leaf emergence and a maximum plumule length of 3.8cm at 144hrs and 4.5 cm at 168 hrs (Table 2).

The data summarized in Fig. 3-4 show that vegetable and fruit waste decoction increased plant length to 7cm and crude extract to 6.7cm for 1:8 dilution, respectively. While the plants grown in distilled water (control) showed a plant length of only 2.3cm.

When the tomato plants were assessed for their total biomass content, by analyzing fresh and dry weights of shoots and roots, there was profound increase in the plants grown under treatment (both decoction and crude extract) compared to control (Fig. 5-8).

Peels of banana, pomegranate, sweet lime and orange are highly rich in potash, ion, zinc, etc. The powder of fruit peels extract was used as a natural fertilizer, along with fenugreek seeds to test the utilization of fruit peel powder as a natural growth enhancer (Mercy *et al.*, 2014). Similar effect was observed by Tam and Tiquia (1994) while using spent litter to enhance seed germination rate. Vegetable waste provides good amount of nutrients for inhabiting microbes, they are neither pathogens nor concerned with human health. However, they are prone to strong odors during decomposition. The high moisture content of vegetable waste makes it expensive to dispose it off (McGuckin *et al*., 1999). The breakdown of organic material of compost is performed by aerobic microbes which inhabit the soil. These organisms utilize the complex nutrients of the compost and release the essential minerals into soil which in turn enhance the crop yield that provides healthy and nutritious food to mankind (Kalpana *et al.*, 2011). Results of current experiment showed that vegetable and fruit waste has potential to promote and enhance plant growth. The use of domestic waste as plant growth promoter ingredient would be one of the beneficial strategies to reduce its accumulation and protect the environment.

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