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VALORIZATION ESSAY OF GREEN KITCHEN WASTE INTO LIQUID FERTILIZER

Bouzid Khadidja[1*] and Bouzid Aman[2]
[1]Higher Agronomic School of Mostaganem, 27000, Algeria.
[2]Faculty of Natural and Life Sciences, University of Abdelhamid Ibn Badis, Mostaganem, 27000, Algeria.
*Corresponding Author Email : k.bouzid@esa-mosta.dz
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ABSTRACT

The management of household waste is one of the major environmental problem and topicality. Although their chemical composition is very rich in organic matter, this waste is untapped and not recovered. The option of using from mixed vegetable and fruit wastes biofertilizer as a liquid-based fertilizer for agricultural crop production was evaluated through plant growth studies using seeds chickpea (*Cicer arietinum* L.). This research used a randomized block design arranged in factorial with 2 factors and 3 replications undertaken to determine the effects of biofertilizers on the growth of Chickpea cultivation in Mascara University, in western Algeria. Seedling growth trials were conducted over a period of 6 weeks and evaluated for overall plant aerial and root part in response to various applications respectively with tap fresh water, the filtrate and the "corrected" pH filtrate under laboratory conditions. biological fertilizer showed very significant at a confidence level of 95% on the growth of Chickpea.
***Keywords*: ** Green waste, essay, biofertilizer, Algeria, *Cicer arietinum* L.

Introduction

Billion tons of green waste kitchen is being produced yearly for human consumption. Choosing sites to bury household and similar waste It remains a good option. It mobilizes land indefinitely and does not encourage the recovery of waste which is a biomass whose recovery techniques are known. The use of synthetic fertilizers and crop protection products in developing countries has increased dramatically. Increased in recent years. This is one of the most controversial topics when it comes to agricultural development. Liquid fertilizers from various sources of green waste can be an alternative option to assist or replace substitute the prevailing system.

The use of biofertilizers as an alternative to chemical fertilizers increases vegetative growth, yield and fruit quality in vegetable crops (Poudel *et al.,* 2002). The challenge of managing the liquid fertilizer may also represent an opportunity if the nutrients can be recovered to offset the use of synthetic fertilizers, which are manufactured through energy-intensive processes and non-renewable resources (Maurer *et al.,* 2003). Fruit and vegetable peelings are increasingly used as ingredients for the formulation of functional foods for their antioxidant activity (Romelle *et al.,* 2020).

According to the National Waste Agency (AND), Algeria produces 10.3 million tons of MSW each year or 28.219 tons per day, with a collection coverage of 85% in urban areas and 60% in rural areas, and a rate of 0.9 kg/ inhabitant/day for urban zones and 0.6 kg/inhabitant/ day for rural zones. It is clear increasingly under pressure from population growth, strong urbanization and improved living standards will generate increasingly high volumes of waste in the future. However, in Algeria, the generation of urban solid waste is experiencing a significant increase. It is estimated at approximately 8.5 million tons per year, or 23.288 tons per day in 2005. In 2018, the quantity of household and similar waste (DMA) in Algeria, reached about 13 million tons, will have to exceed 20 million tons in 2035 (Djemaci, 2012).

Every year 120–140 million tons of bio-waste are generated in Algeria, most of which is land filled, incinerated or stabilized and used as covering material in landfill operation. The growth of household green waste has been skyrocketing as a result of growing urban population. So, the viable solution is to convert these wastes in a useful product such as liquid fertilizer. Urban regions have a critical issue of green management waste because of its high growing rate of production.

The extensive use of inorganic fertilizers has increased the salinity of soil and decreased optimal assimilation of nutrients by crops. The objective of this study was to develop a process for recovering organic carbon using compost from mixed municipal waste as raw material. The use of fertilizers from organic residues could replace mineral fertilizers, contributing to resources preservation and recycling of organic matter.

According to (Lynch and Theroleof, 1998) global agriculture urgently needs more nutrient efficient crops, i.e. higher yields with suboptimal nutrient availability and reduced fertilizer requirements for optimal yields. Among the low-input agro-ecological features of developing countries, nutrient deficiency is a major constraint on crop productivity as well as food security and economic development. Intensive fertilization is costly, causes a lot of environmental pollution and is unsustainable. Continued soil degradation reduces soil fertility and soil responsiveness to fertilization in rich and poor countries. The accelerating impacts of global climate change are likely to exacerbate land degradation and limit crop yields (Lynch and Clair, 2004), especially in developing countries (Clair and Lynch, 2010).

Organic farming is a method of farming systems that manage to create an eco-friendly environment that achieves a sustainable productivity without the use of chemical inputs such as fertilizers, weedicides and pesticides. Liquid compost fertilizer can recover and make available nitrogen, phosphorus and potassium (NPK), which are commonly spread on agricultural land to replace or supplement mineral/synthetic fertilizer.

The recovery and recycling industry currently represents only 2 to 5% at most of the waste produced each year. After ten years and the creation of 80 Technical Landfill Centers (TLC), it is time to make a diagnosis of the quality of the management of green household waste and to adopt an initial strategy for fertilizing plant production of waste. By embracing setting up an experiment to recover green kitchen waste, substantial green waste could be diverted from landfill (Bouzid *et al.,* 2019).

Chemical fertilizers have appropriated agricultural. Demand for nutrients (nitrogen, phosphorus and potassium, NPK) will increase over time to meet demand. However, inorganic fertilizers harm the environment through excessive or inappropriate phytochemical fertilization. Some of the adverse effects include greenhouse gas emissions, surface water eutrophication, and excessive plant nutrition (Coskun *et al.,* 2017; Liang *et al.,* 2013; Walling and Vaneeckhaute, 2020). On the other hand, some benefits of organic fertilizers are the improvement of organic carbon in soils and the slow release of nutrients that do not harm plants (Sharma *et al.,* 2019). Hence, the need to replace inorganic fertilizers with organic fertilizers is becoming more and more pressing. According to (Campuzanoand González-Martínez*,* 2017; Fernández-Delgado *et al.,* 2019) numerous studies have demonstrated the possibility of producing organic fertilizers from organic waste.

Vegetable and fruit wastes have which are beneficial components and can be easily collected from farms and processing factories but are also commonly produced as mixed waste in restaurant and canteen kitchens. Diversion of green kitchen waste from landfills offers an opportunity to recover valuable nutrients such as liquid fertilizer that are typically discarded.

Attraction in organic farming is increasing in Algeria and this interest has been promoted by the Algerian government. In addition, the present cost of chemical fertilizer is ten times higher than biological fertilizer. Hence, under the potential constraint of chemical fertilizer cost and the benefits of organic farming systems, poor farmers who own degraded farmlands may consider using more organic farming in the future. Kitchen green wastes are commonly renewable, cheap and produced in large quantities daily. However, the advantages of kitchen green wastes in biofertilizer production are indeed an untapped resource and poorly documented due to the challenges in the handling and disposal of kitchen wastes. Accordingly, the purpose of this work was a trial to evaluate some functional properties of filtrate obtained from fruit and vegetable peel waste of kitchen, in order to use them as a biofertilizer source on growth and yield of cultivation chickpea.

Materials and Methods

This research was conducted from February to July 2021 at botanical laboratory at the University of the Mascara-Algeria.

Material and Tools of the Research

Deposit type

In order to identify the average amount quantitative and qualitative composition of waste fruit and vegetable, 5 families from Mascara city North West of Algeria which has more than 180,000 inhabitants (Fig. 1), were monitored every week for 6 months, from February to July 2021. Families of each socio-professional category (Senior executives and engineers, social workers, liberal profession and retiree) were followed and the following results were obtained (Table 1).

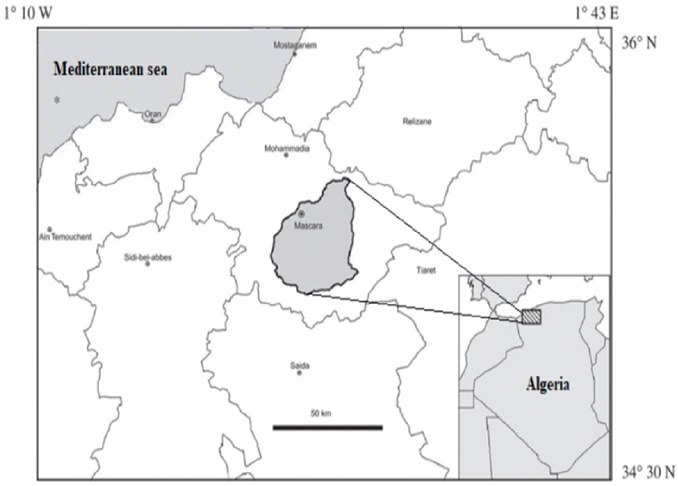

Fig. 1: Geographical location of the city Mascara

Table 1: Quantity of green waste generated in a week at households

Quantity in grams per family per week					
Period	4 Persons	5 Persons	6 Persons	7 Persons	11 Persons
February	1.680	2.510	3.250	4.600	6.720
March	2.920	3.420	4.220	5.800	6.729
April	2.250	4.100	3.503	4.400	7.320
May	3.440	4.10	4.730	6.120	5.312
June	1.90	2.14	3.880	5.312	8.10
July	2.200	4.15	3.670	3.120	7.321
Average	2.358	3.245	4.033	4.858	6.689
average per person	589	649	672	694	608

The use of these figures makes it possible to quantify the average annual tons of fruit and vegetable peelings that can be recovered as liquid fertilizer. The average production per week and per person of this deposit being 642 grams per week, in total about 34.5 kg per person. Green waste reaches to 125.000 tons per year.

Experimental method required

Consumer concern over the quality and safety of conventional food has intensified in recent years, and primarily drives the increasing demand for organically grown food, which is perceived as healthier and safer. Organic fruits and vegetables can be expected to contain fewer agrochemical residues than conventionally grown alternatives; constraints also had significant impacts on chemical fertilizer use are posed both organic and conventional agriculture. Most, if not all, commercially purchased fruits and vegetables contains trace amounts of agricultural pesticides.

Quantification of green Waste

To carry out the test, a sample of fruit and vegetable peelings was taken from 4 families for one week during the month of April 2021, a period when fruits and vegetables are abundant.

Food waste collection was done on daily basis. Daily collected waste weighted and dumped to the research site. Quantification of daily generated the waste households peelings of vegetables and fruits was presented in the Table 2.

Table 2: Quantitative aspect of raw materials used.

Composition	Weight in grams per week		
	Minimum	Maximum	Average
Cauliflower	231	343	287
Potato	1045	674	859
Onion	209	112	160
Zucchini	823	515	669
Carrot	117	230	173
Beet	308	25	166
Salad	512	322	417
Banana	754	221	487
Orange	809	117	463
Tomato	112	276	194
Celery	47	71	59
Bean	58	99	78
Pepper	98	105	101
Lemon	124	146	135
Turnip	95	121	108
Grape	35	67	51
Apple	73	98	85
Apricots	27	37	32
Plum	21	42	31
Fig	51	67	59

Grinding, pressing and mixing technology

The operation consists of extraction mechanical on the green waste to extract a liquid. Green waste is shredded mechanically (> 20 mm) and was ground with the help in a Blik® M420 grinder and screened to < 10 mm. The samples were stored in a cold room (5 ± 2°C) before carrying out the characterization tests.

Stages of research

Block preparation

Plant material

Experiments were carried out on chickpea seeds (*Cicer arietinum* L.) Medium-sized seeds were kept in a refrigerator at 7°C for a long time, in anticipation of dormancy. This work was carried out in the botanical laboratory at the University of Mascara-Algeria, the conditions of cultivation were kept semi-controlled. For use, these seeds underwent a first bath in 8% sodium hypochlorite solution for three minutes to disinfect and remove impurities. They are then rinsed several times with distilled water to remove all traces of chlorine. The seeds, once dried under ambient conditions, are placed in a petri dish for germination. From the first germinations, the seedlings are carefully transplanted into pots while waiting for the application of the filtrate.

Chickpea seeds (*Cicer arietinum* L.) were used in the study. The experiment was conducted for a period of 45 days. Seeds were sown in pots. The experimental design included 30 pots divided into three batches of 10 were established three different treatments respectively (irrigation with tap water, filtrate and pH-corrected filtrate) along in a randomized complete block design. After planting, each pot was irrigated weekly with the appropriate treatment.

Liquid Organic Fertilizer preparation and Application

The liquid organic fertilizer to be used is derived from easily available fruit waste and peelings materials. All ingredients were ground by grinding, then added water. This biological fertilizer was kept in the shade at room temperature in order to ferment for 2-4 days alter mixing and ready to use. After the fermentation process is complete, the liquid organic fertilizer extract is separated from its constituent materials by filtering. The liquid organic fertilizer is stored and is ready to be applied.

Measurement of root extension and branching. Respectively, fifteen, thirty and forty-five-day-old plants were removed from their culture vessel, taking care not to damage the root system.

Study of plant material

The study of the plant material was carried out by observations and biometric measurements on roots and stems.

Parameter of Observation

Plant Height and root

Plant height and root was measured respectively after 2 weeks after planting, then measurements were carried out 4 weeks and 6 weeks. Plant height was measured from the base of the stem or soil surface to the highest part of the plant.

Experiment Design and Data Analysis

The experimental design used in this study was a Randomized Block Design. The treatment was arranged in a factorial with two factors and three replications. Statistical analysis was performed by using analysis of variance (ANOVA) followed by Newman–Keuls test to determine the differences among the means of all experimental groups and to establish significance the 5% threshold averages among all groups. Analyzing the quality of the solution resulting from the crushed and filtered waste

An analysis physicochemical of the filter of two samples was carried out and revealed the following results (Table 3).

Results and Discussion

Physico-chemical properties of liquid biofertilizer

The results of the preliminary analysis of the physico-chemical properties organic fertilizer were presented in Table

3. In general, plants like a neutral pH, at a pH between 6.35-6.87.

The positive influence on chickpea growth was observed in pH-controlled operation of than the experiment without pH control and tap water. The results obtained in this section are very interesting since there is presence of the main elements as confirmed by the numbers summarized in Table 3.

Table 3: Physico-chemical analysis properties biofertilizer.

Parameters	Sample 1 (mg/l)	Sample 2 (mg/l)
Potassium K_2O	78	89
Calcium CaO	65	61
Magnésium MgO	69	53
Phosphorus P_2O_5	65	76
Total nitrogen	183	158

Suspended matter (SM)	176	182
Turbidity NTU	3.13	2.47
pH	6.87	6.35

Effect of liquid biofertilizer on the growth of chickpea

The results of the analysis of variance on the growth of plant are presented in Tables 4 and 5. Based on the research data, the application of liquid biofertilizer on three chickpea cultivars significantly increased the height and root. Another research reported that the application of organic fertilizer such as biofertilizer which is applied to the soil would stimulate generative growth and soil environment because the organic fertilizer will improve the physical, biological, dan chemical soil properties which could be supporting the growth of a plant (Pangaribuan and Hendarto, 2018).The effects of activator treatment on the chickpea growth (*Cicer arietinum* L.) were dependent on filtrate type.

Table 4: Analysis of variance of effect of watering treatment on length of stem of *Cicer aritrium* L.

Source of variation	df	Sum of squares	Mean Square	F	Pr> F	S
Tap water						
Treatment	2	990,5644	495,2822	25183,8395	< 0,0001	THS
Error	6	0,1180	0,0197			
Total	8	990,6824				
Source of variation	**df**	**Sum of squares**	**Mean Square**	**F**	**Pr> F**	**S**
Filtrate						
Treatment	2	2357,1202	1178,5601	45680,6232	< 0,0001	THS
Error	6	0,1548	0,0258			
Total	8	2357,2750				
Source of variation	**df**	**Sum of squares**	**Mean Square**	**F**	**Pr> F**	**S**
Filtrate with pH-corrected						
Treatment	2	2956,0897	1478,0448	27993,2736	< 0,0001	THS
Error	6	0,3168	0,0528			
Total	8	2956,4065				

Table 5: Analysis of variance of effect of watering treatment on length of root of *Cicer aritrium*L.

Source of variation	df	Sum of squares	Mean Square	F	Pr> F	S
Tap water						
Treatment	2	16,5884	8,2942	1584,8811	< 0,0001	THS
Error	6	0,0314	0,0052			
Total	8	16,6198				
Source of variation	**df**	**Sum of squares**	**Mean Square**	**F**	**Pr> F**	**S**
Filtrate						
Treatment	2	13,4952	6,7476	1076,7447	< 0,0001	THS
Error	6	0,0376	0,0063			
Total	8	13,5328				
Source of variation	**df**	**Sum of squares**	**Mean Square**	**F**	**Pr> F**	**S**
Filtrate with pH-corrected						
Treatment	2	13,6900	6,8450	211,4097	< 0,0001	THS
Error	6	0,1943	0,0324			
Total	8	13,8842				

Induced enhancement of Watering with pH-corrected filtrate at 45 days showed a very strong positive correlation (R2=0.999). In quantitative assay, watering by filtrate pH corrected was significantly higher than other watering at different incubation time. Plants were further assessed for their watering potential in at different time intervals. Analysis of the results obtained after 45 days allows the following observations:

Branching of roots is more developed, concentrated and voluminous for irrigation with liquid fertilizer at pH corrected compared to that based on filtrate and tap water.

Analysis of the results obtained after 45 days allows the following observations (Fig. 2): branching of roots is more developed, concentrated and voluminous for irrigation with liquid fertilizer at pH corrected compared to that based on filtrate and tap water. Application of pH-corrected filtrate showed higher growth than tap water and filtrate.

15 days after growth, the root system was similar for all plants for the 3 types of watering (Fig. 2). In fact, at this stage and in contrast to stems, effect of the filtrate on plants is not yet noticed.

At 30 days of growth, the stems of seedlings watered to pH corrected filtrate have a considerable length in comparison to that obtained at 15 days of growth (51.89 cm against 19.94 cm).

After six weeks, the action of the pH-corrected filtrate on the root system seems very dense compared to other waterings.

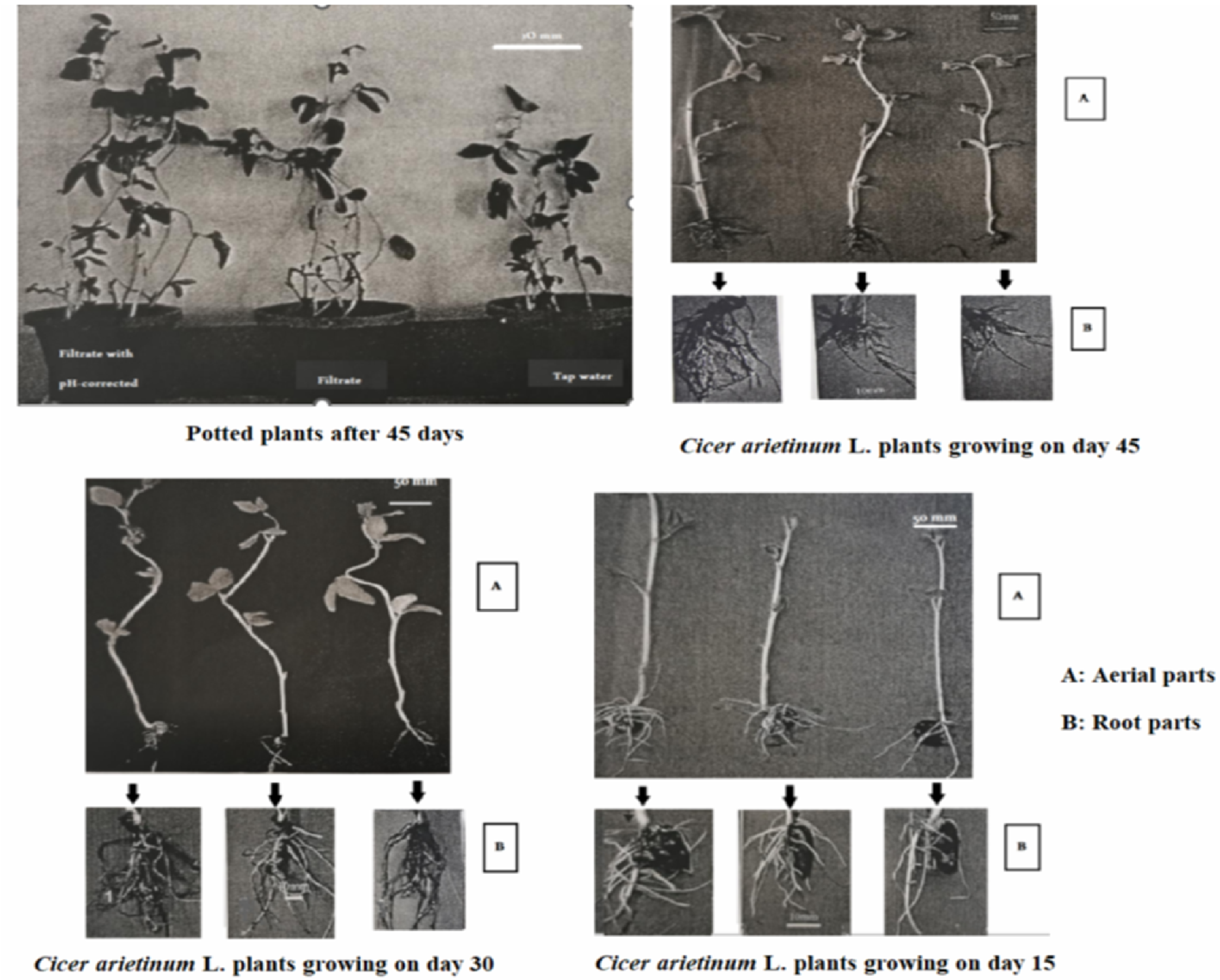

Fig. 2: Plant growth in under different treatments, (Photo: Bouzid, 2021).

Effect of 3 different treatments on the growth of on stem lenght after 45 days

The results obtained on the effect of the treatments on the stem length (Fig. 3) (Table 6), revealed that the filtrate with pH corrected has an average stem length of 62.39 cm, for batch treated with filtrate the length is equal to 51.15 cm, for tap water is equal 33.60 cm.

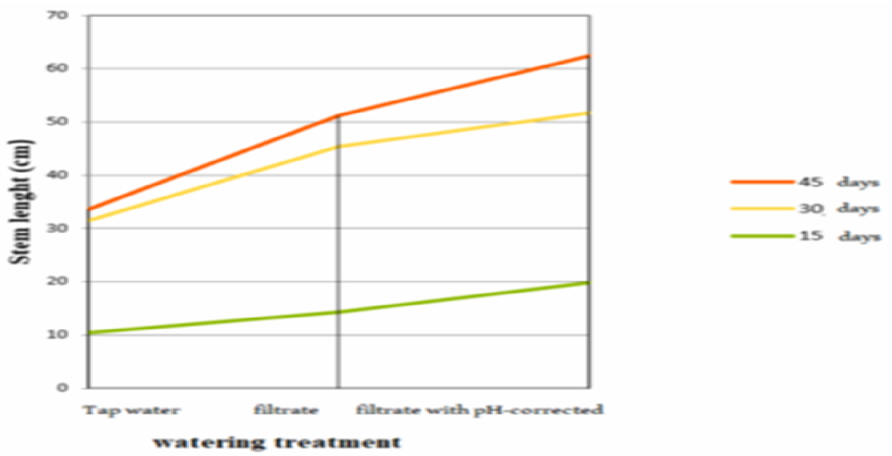

Fig. 3: Stem length kinetics in the different treatments.

Table 6: Comparison and classification of the means according to 3 different treatments on stem length.

Parameter	Tap water				Filtrate				Filtrate with pH-corrected			
Modality	Average	Homogeneous groups			Average	Homogeneous groups			Average	Homogeneous groups		
45 days	33,6067	A			51,1567	A			62,3933	A		
30 days	31,4533		B		45,4033		B		51,7467		B	
15 days	10,3533			C	14,3133			C	19,7467			C

Effect of 3 different treatments on the root length

The results obtained on the effect of the treatments on the root length (Fig. 4) (Table 7), revealed that the filtrate with pH corrected has an average stem length of 11.62 cm, for batche treated with filtrate the length is equal to 9.33 cm, for tap water is equal 8.33 cm.

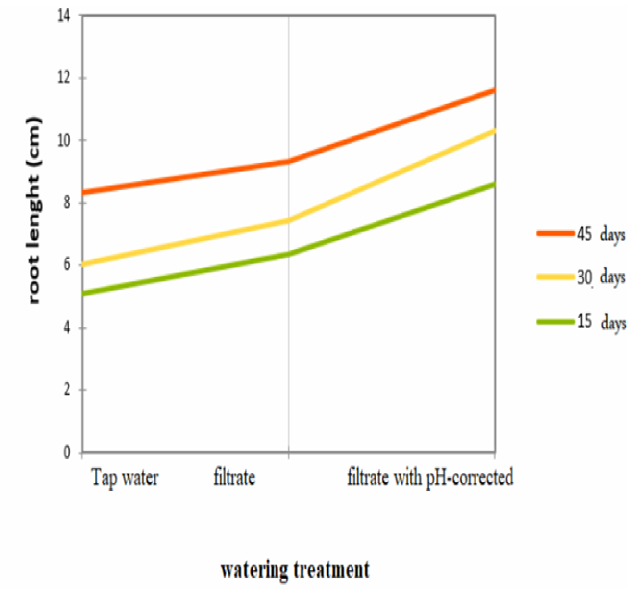

Fig. 4: Root length kinetics in the different treatments.

Tables 6 and 7 shows three homogeneous groups, the first group (A) represented by the filtrate pH corrected, the second group (B) represented by the filtrate, the third group (C) represented by the tap water respectively.

Variance analysis shows that the filtrate with pH corrected at a very highly significant difference ($p \leq 0.0001$) (Tables 4 and 5).

Table 7: Comparison and classification of the means according to 3 different treatments on root length.

Parameter	Tap water				Filtrate				Filtrate with pH-corrected			
Modality	Average	Homogeneous groups			Average	Homogeneous groups			Average	Homogeneous groups		
45 days	8,3367	A			9,3300	A			11,6200	A		
30 days	6,0467		B		7,4300		B		10,3000		B	
15 days	5,1033			C	6,3700			C	8,6067			C

Conclusion

Our present study has revealed that liquid fertilizers individually enhance the growth of chickpeas plants. Based on these experimental data, it is possible to developed of an alternative biological system for the fertilization of vegetable crops by using local organic fertilizers and biopreparations. The findings provide an alternative for organic farming, a less environmental-friendly alternative and help eliminate green waste. Liquid composting is an important element in sustainable waste management for the Algeria and could potentially have a vital role to play in meeting the obligations of the Landfill Directive. Algeria has created a green momentum by launching an ambitious program to develop green waste is one of most important sources of biomass potential in Algeria, which can be used as biofertilizer. To finalize this valorization, it is necessary to reproduce the experimental at a larger scale and above all to refine the physicochemical analysis shall be suited to the needs of the plants and recommendations of the standard ISO 9004.

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