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Full Length Research Article

The Effect of Vermicompost, Cocopeat, Sand and Soil to Enhance Productivity of Vegetables

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Abstract

Fenugreek, bitter gourd, chilli, lady's finger, brinjal, tomato from germination to growth and cultivation of vegetables were noted. In the present study, by optimizing composition of vermicomposting with the addition of other components like soil, sand, vermicompost, cocopeat, soil: sand, soil: cocopeat, cocopeat: vermicompost, sand: vermicompost, soil: vermicompost: cocopeat, soil: sand: vermicompost: cocopeat and experimental treatments were conducted from 2021 to 2022 to elucidate the effect of vermicompost along with different components and without addition only soil as control. The figure 5 GC-MS analysis for fenugreek control and figure 6 for optimized compost. Dimethyl phthalate, 1, 2-Benzedicarboxylic acid and ethyl methyl ester, dimethyl phthalate, cholest-3, 5- diene and 2, 2- dimethoxybutane, dodecane, dimethyl phthalate, 1, 2-benzedicarboxylic acid and ethyl methyl ester, diethyl phthalate are phytocompounds of fenugreek. The positive effect by addition of optimized compost is most suitable for all vegetables except bitter gourd and brinjal. The Glutamic acid, Aspartic acid and Arginine this compound found in chilli sample. Different vegetables have different analysis but vitamin content from optimized composition and have high vitamin content. Thus, the result of optimized composition was suggested for cultivation of vegetables at home gardens to maintain healthy life.

***Key words*:** Vermicompost, Cocopeat, Sand, Soil, Seed germination, Growth response, GC-MS, Therapeutic activities

The Corona global crisis was caused by a virus that infected billions of people worldwide and killed millions. With the panic from the COVID-19 coronavirus spreading, people are realizing that our food production systems aren't as strong as they expected, and that unaware panic purchasing by a small quantity of the population can disturb the just-in-time food source limitations used almost universally in the modern world, even if there's plenty of food to go round. Starting our own garden and growing our own food can be an empowering exercise in increasing self-belief. It became a challenge in COVID-19 condition to cultivate vegetables at our own gardens or farms. Now a days, by considering the population and the need of vegetables cultivation is abundant. Many people do agriculture business in India. In India, the agriculture plays an important role for economic development [25]. Plants need soil, light and water to grow. Fruit trees require a minimum of 6-8 hours of direct sunlight. Using irrigation for regular watering and frequently feeding plants with fertilizer. First environmental conditions must trigger the seed to grow. The germination of most seeds and spores occurs in response to warmth and water. Fenugreek (*Trigonella foenum-graecum* L.), bitter gourd (*Momordica charantia* L.), chilli (*Capsicum frutescens* L.), lady's finger (*Abelmoschus esculentus* (L.) Moench), brinjal (*Solanum melongena* L.), tomato (*Solanum lycopersicum* (L.) H. Karst) seeds used in seed germination. Any vegetable which flower and fruit such as chilli, brinjal, tomato, lady's finger and Bitter gourd will need a minimum light. Fenugreek need a low light. Due to chemical fertilizer used the substances present may affect to the soil ecosystem as well as on plant productivity. We like to use vermicomposting because vermicomposting is an organic manure produced by earthworms fed pure cow dung. It can be used as fertilizer for production of crop [9]. The final product is used as plant growth regulator as it was rich in plant nutrients, odourless with moisture holding capacity. The vermicompost contain plant nutrient like N, P, K, Ca, Mg, Zn and Cu [39]. The agriculture productivity of plant increased in India [20]. The vegetables are the important source for human diet because they supply essential nutrients for human body. If vegetables are attacked by pests and diseases then they damage the quality of yield and residues of plant [8]. We like to use cocopeat because cocopeat is not only a natural, organic product, but also renewable one with a slightly. The "*Eisenia fetida*" and "*Eisenia andrie*" are the species most commonly used in vermicompost [9]. The importance of biologically active compounds or phytocompounds for the understanding therapeutic activities

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[42]. Vermicompost can increase the fertility and they produce nutritive vegetables and fruit and also it is safe for human health [1]. The earthworm plays a role in the process of soil and organic matter [12]. Vermicomposting is the production of pathogen free fertilizer and also it protects environment because it used by waste raw material [57]. The vermicompost technology can enhance the quality of compost with good plant nutrients [1]. It is the most environmentally and eco-friendly safe nutritional and mineral supplement for organic crop production [9]. The vermicompost is the simple and stable organic product and peat like substance [12], [34], [37]. They are safe and nutritious for fruit and vegetables [39]. Vermicomposting can enhance the physical properties of soil and also soil health status [39]. The vermicompost have high holding water capacity and also low C: N ratio [12], [34], [39]. Vermicomposting is the aerobic process and also have nourishing organic fertilizer [23]. The macronutrients in vermicompost are the nitrogen, phosphorus and potassium and micronutrients in vermicompost are iron, copper, zinc and manganese [14]. Vegetables are the important source of medicines [18]. It is an important constituent for human health. The vegetables are important for human diet because they contain vitamins, carbohydrates and proteins [45]. After cultivation the GC-MS analysis of were done to analyze significant difference in amount of phytocompounds. The GC-MS technology is a key platform because they are detected in plants and also in animal species [29]. It also chromatographic technique to calculate R*f* value. The GC-MS data can be collected from good samples and they provide good information about biological samples [31]. The GC-MS analysis is the strong method because they identify the presence of phytocompounds in the parts of plant [42]. The Agricultural Health Study (AHS) reported that certain pesticide is the key factor of cancer risks in population of agriculture and these cancer risks are lip cancer, brain tumors, prostate cancers, lymphatic and hematopoietic cancers [28]. Many people use pesticide at their own risk and they died because of pesticide poisoning [17]. The normally seed germinate in vermicomposting take 5-8 days. The normally flowering in vermicomposting take 1.15 month. The normally seed germinate in cocopeat take 1-4 days. The normally flowering in cocopeat takes 4-7 days. The normally seed germinate in soil take 1-2 weeks. The normally flowering in soil takes 3 month 5 days. Fenugreek (*Trigonella foenum graecum L.*) is an annual plant in the Fabaceae family, with leaves consisting of three small obovate to oblong leaflets [46-47]. It is cultivated worldwide as a semi a ride crop. This plant is used in many parts of the world especially in Bangladesh, Egypt, India and China, etc. [47]. The Rajasthan is the famous state of fenugreek production [46]. This state has largest cropped area. It is also used in traditional medicine. The phosphorus deficiency tends to low yield of legume crops on all types of compost [46]. Bitter gourd (*Momordica charantia* L.) grown mainly in tropical and subtropical places of Africa, Asia and America [55]. The growing states are Maharashtra, Gujarat, Rajasthan, Punjab, Tamil Nadu, Kerala, Karnataka, Andhra Pradesh, West Bengal, Odisha, Assam, Utter Pradesh and Bihar. It is a warmest season crop. It is generally grown in Southeast Asia, China, Africa and India [55]. The bitter gourd is used for medicine in India, Africa and China and this plant are also used to treat various cases like jaundice, pneumonia, piles, gout [32], [55]. Chilli (*Capsicum frutescens* L.) is the fruit of plants from the genus capsicum and members of the *Solanaceae* family. India is the largest producer and consumer and also exporters of chilli [50]. There are many varieties of chilli plants, some of which are the hottest peppers known. C. frutescens is a high source of vitamin C [27]. They contain zinc, manganese and also copper [27]. It is used as a principle ingredient various curries and chutneys and also used in vegetables, spices, condiments, sauces and pickles [50]. The hot pepper is a generally cultivated in India [50]. The absence of copper are the symptom of small growth of plant and development [27]. Tomato (*Solanum lycopersicum* (L.) H. Karst) one of the most important vegetable plants in the world. The tomato is originated from central and south America [43]. The tomato plant has many interesting features such as fleshy fruit, a sympodial shoot and compound leaves, which other model plants do not have. The major tomato growing countries are China, India, Italy, Egypt and USA. The tomato plant needs nitrogen, phosphorus and potassium nutrients. They need full sun, rich soil and warm temperatures. The China is the no-1 and India is the no-2 in total world production of tomato. They contain average quantity of minerals, vitamins and soluble sugar and organic acids [43]. The β carotene and ascorbic acid is the important source of tomato plant and also, they contain vitamin A, C and E and minerals [43], [49]. The vitamins and minerals are good for human body because they protect human body from diseases [49]. Okara plant are easy in growing and also a better nutritional value [13]. Okara is the annual and warmest season crop [19]. The vermicompost are grow the yield of Okra [36]. They provide vitamins such as vitamin C, A, B complex, calcium, potassium, iron and other minerals for human body [19]. Brinjal (*Solanum melongena* L.) is also known as *"Guinea squash"*, is a member of the nightshade family [2]. It belongs to Solanaceae family [22]. The brinjal is beneficial for human health because they have low in calories and minerals [2]. The plant is grown for its purple fruits that are usually baked, boiled or fried. The potassium, calcium, magnesium and iron and carbohydrates and fiber, phosphorus is the rich source of brinjal plant [2], [22]. Brinjal family contains 75 genera and 2000 species [22]. They are not considered as major crop except in Asia, where the plants are grown on a fairly wide scale in China, India and Japan. The brinjal juice of leaves are very beneficial for throat and stomach trouble for human [22]. These plants are alkaline in nature. Cocopeat is the natural and non-renewable resources [35]. The cocopeat have a better physical property and slow biodegrading and pore space [38]. The nitrogen, potassium, phosphorus and magnesium and zinc are the nutrients available in cocopeat. Mostly cocopeat are used in horticulture, germination of seeds and vegetable cultivation [35], [38]. It is made from coconut husk after the extraction of fiber and cocopeat have a high holding water capacity [4], [16]. It is unwanted material of the coconut industry [16]. The cocopeat is a light and it is a natural organic supplement. It is easy to use and free from phytopathogens and also, they contain nutrients like potassium, sodium and manganese [16]. The cocopeat pH is neutral. The nutrients in the soil are the important part can affect the growth of plants. The environmental factors contain biotic and abiotic factors. The soil type is the most important abiotic part affect the plant growth. The plant growth promoting microorganisms (PGPMs) are help to plant for absorb nutrients from soil [56]. Thus, the study has been carried out to evaluate the effect of vermicomposting and optimized fertilizer on seed germination, plant growth, contained of vitamin and average yield of vegetables. Overall, our study provides beneficial effects of optimized fertilizer for plant growth with active metabolites.

MATERIALS AND METHODS

Selecting a site for new garden bed

Sample collection: Seeds were done from the market of Osmanabad (Maharashtra) India. The fenugreek (*Trigonella*

foenum-graecum L.), bitter gourd (*Momordica charantia* L.), chilli (*Capsicum frutescens* L.), lady's finger (*Abelmoschus esculentus* (L.) Moench), brinjal (*Solanum melongena* L.), *Tomato* (*Solanum lycopersicum* (L.) H. Karst) seeds are used in home garden. The healthy seeds are screen from the collected package and sowed into soil with a different optimize condition.

Preparation of soil: We using soil, sand, cocopeat, vermicompost, soil: sand, soil: cocopeat, cocopeat: vermicompost, sand: vermicompost, soil: vermicompost: cocopeat, soil: sand: vermicompost: cocopeat for sowing seed prepare garden soil accordingly used. Optimization of soil by using different composition as a trial.

Sowing seed: Sow the seed at the right time of the year as per environmental conditions. The environmental conditions must trigger the seed to grow. The water activates special proteins called enzymes that begin the process of seed germination.

Germination: Everyday observation to check germination time of seeds and provision water as per the need. After germination of seed every week measurement of height and phases of growing vegetables, flowering and fruiting, etc. In this experiment, fenugreek was collected from suitable from suitable optimized soil and shade dried and converted into powdered form for the further GC-MS analysis cold extraction were carried out to collect extract or sample for further analysis. In this study, we using three methods are as follow:

Estimation of chilli by volumetric method

The standard solution of 5 ml is pipette out in conical flask of 100 ml [41]. Then add 10ml of 4% oxalic acid and the content of the sample are titrate against the dye (V_1ml) because they achieved pink end point for few minutes [41]. The sample of chilli (3 g) were extracted in 4% oxalic acid and the volume are make up to 100 ml and then centrifuge the sample [41]. The supernatant of 5 ml is pipette out. Then add 10ml of 4% oxalic acid and titrate against the dye (V_2ml) [41]. The ascorbic acid formula as follow:

Amount of ascorbic acid (mg/ 100g) = (0.5 mg ÷ V_1) × (V_2 ÷ 5 ml) × (100 ml ÷ weight of sample) × 100 [41].

Thin layer chromatography

Use a beaker or closed jar for thin layer chromatography [5]. Then, use pencil to mark the position of plate from starting line [10]. If the solvent is moving later 15 to 45 minutes nearly 1cm then remove the developing chamber of thin layer chromatography and allow the solvent to evaporate with hot or cold air [5], [10]. Then, remove the plates and allow to dry with heat burner before visualization [10]. The colored spot of sample can be directly observed [5]. If the colored spot not directly observed then the sample spots can see in UV light on the plate [5]. The resulting ratio is also known as R*f* value and the R*f* formula are as follow [5].

R*f* = Distance of centre of spot from starting point ÷ Distance of solvent front from starting point [5].

GC – MS analysis

The analysis of fenugreek leaf extract using GC-MS technology connected with mass spectrometry [11]. The sample-1 is in the control of fenugreek and sample-2 is in the soil: sand: vermicompost: cocopeat. The bioactive phytocompound identified with therapeutic activities and it is shown in (Table 2-3). The source temperature of GC-MS technology is 250 °C [48]. The injection volume of sample-1 of control is 3.00mL HS and the injection volume of sample-2 of soil: sand: vermicompost: cocopeat is 3.00mL HS [18], [29]. The analyzed time of sample-1 in control is 2:33:01 and the analyzed time of sample-2 in soil: sand: vermicompost: cocopeat is 3:29:42 [48]. The mass spectrum of identified phytocompounds conducted with NIST17 library database and it is shown in (Fig 5-6) [11], [29].

Preparation of extract

The grown and cultivated whole plant extract of fenugreek in soil and soil: sand: cocopeat: vermicompost was collected from home garden and crushed to liquid then this liquid dried in plate of both sample of fenugreek with using alcohol [18]. Then, the whole plant powder form of fenugreek was transferred to capillary column and then it is processed with methanol [29]. Then, it is kept in cool place for 48 hours [29].

RESULTS AND DISCUSSION

The (Fig 1) shows the *Trigonella foenum graceum*, *Momordica charantia*, *Capsicum frutescens*, *Abelmoschus esculentus*, *Solanum melongena*, *Solanum lycopersicum.* We used this plant seeds for seed germination in home gardern. The fenugreek (*Trigonella foenum graceum*) seeds are successfully germinated in all compost (Table 4) [30]. In our result, the bitter gourd (*Momoordica charantia*) seeds are not sucessfully germinated in soil but this seeds are germinate in soil: sand: vermicompost: cocopeat compost (Table 5) [30]. In our result, chilli (*Capsicum frutescens*) seeds are sucessfully germinated in all compost except cocopeat and soil: sand (Table 4) [30]. In our result, the lady finger (*Ablemoschus esculentus*), brinjal (*Solanum melongena*) and tomato (*Solanum lycopersicum*) seeds are suceesfully germinated in compost (Table 5) [30].

Fig 1 A. *Trigonella foenum graceum,* B. *Momordica charantia,* C. *Capsicum frutescens,* D. *Abelmoschus esculentus,* E. *Solanum melongena,* F. *Solanum lycopersicum*

The (Fig 2) shows the fenugreek plant are well grown and leaves are fleshy. The environmental conditions are suitable for fenugreek in soil, sand, cocopeat, vermicompost, soil: sand, soil: vermicompost: cocopeat and soil: sand: vermicompost: cocopeat. In our observation, the total 9 phytocompounds are well detected with therapeutic activities through GC-MS analysis (Table 2-3) [42]. In our result, the fenugreek plant have good medicinal phytocompounds like antidiabetic, anti-inflammatory, antifungal, hair growth stimulant, etc. [21], [42]. In our observation, the vermicompost with added to soil, sand and cocopeat show growth of the fenugreek plant increases [51]. In our result, the soil, sand, cocopeat, vermicompost, soil: sand, soil: vermicompost: cocopeat and soil: sand: vermicompost: cocopeat compost and seed germination show the positive results on fenugreek plant [54].

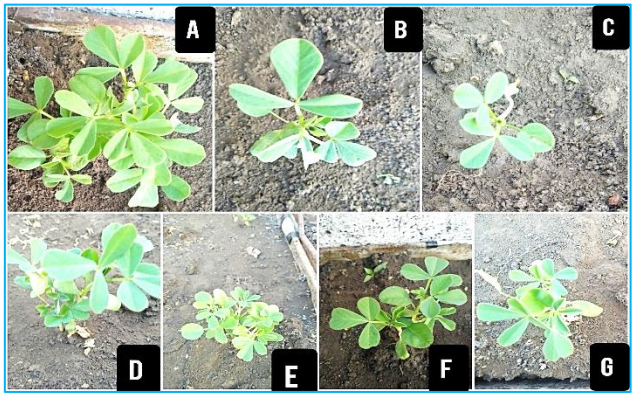

Fig 2 A. Soil, B. Sand, C. Cocopeat, D. Vermicompost, E. Soil: Sand, F. Soil: Vermicompost: Cocopeat, G. Soil: Sand: Vermicompost: Cocopeat

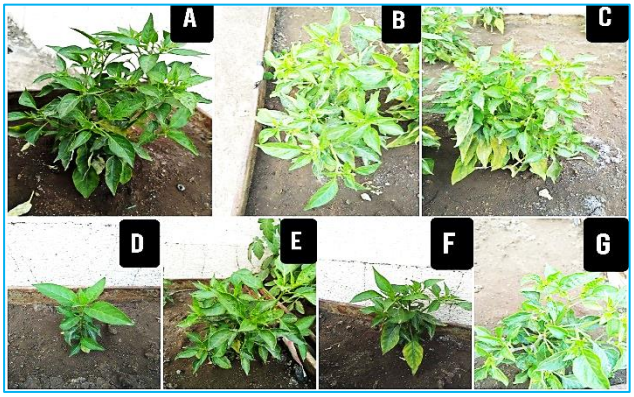

Fig 3 A. Soil, B. Sand, C. Vermicompost, D. Soil: Cocopeat, E. Cocopeat: Vermicompost, F. Soil: Vermicompost: Cocopeat, G. Soil: Sand: Vermicompost: Cocopeat

The (Fig 3) shows the chilli plant are well grown and the leaves are fleshy. The environmental conditions are suitable for chilli in soil, sand, vermicompost, soil: cocopeat, cocopeat: vermicompost, soil: vermicompost: cocopeat and soil: sand: vermicompost: cocopeat. In our observation, the glutamic acid, aspargin and ascorbic acid are found in chilli using thin layer chromatography (Table 6). In our observation, vermicompost is the beneficial compost with added to soil, sand and cocopeat because it helps the growth and yield of chilli plant [62]. In our result, the chilli plants give good results as compared to fenugreek, bitter gourd, lady's finger, tomato and brinjal but fenugreek, lady's finger and tomato plants also give good results except bitter gourd and brinjal plant [44].

The (Fig 4) shows the *Momordica charantia*, *Abelmoschus esculentus* and *Solanum melongena*, *Solanum lycopersicum*. In our observation, the total quantity of lady finger in soil: sand: vermicompost: cocopeat (12gm) is higher than as compared to control (6gm) (Table 5) [53]. The total quantity of tomato in soil: sand: vermicompost: cocopeat (1984gm) is greatest and it is significantly greater than control (36gm) (Table 5) [60]. In our result, soil: sand: vermicompost: cocopeat is most suitable for lady's finger and tomato fruit except bitter gourd and brinjal fruit.

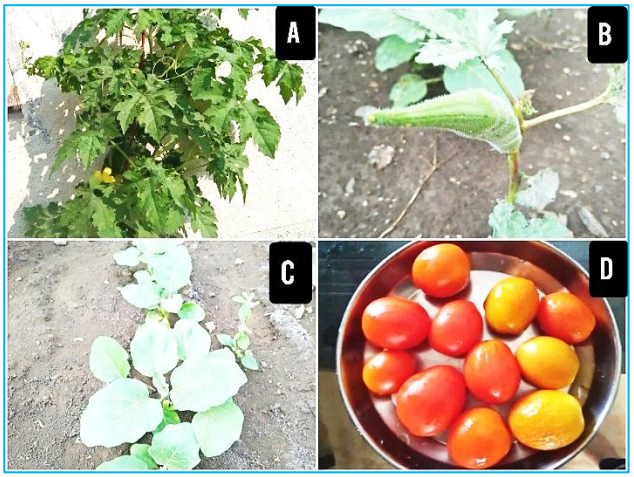

Fig 4 A. *Momordica charantia,* B. *Abelmoschus esculentus,* C. *Solanum melongena,* D. *Solanum lycopersicum*

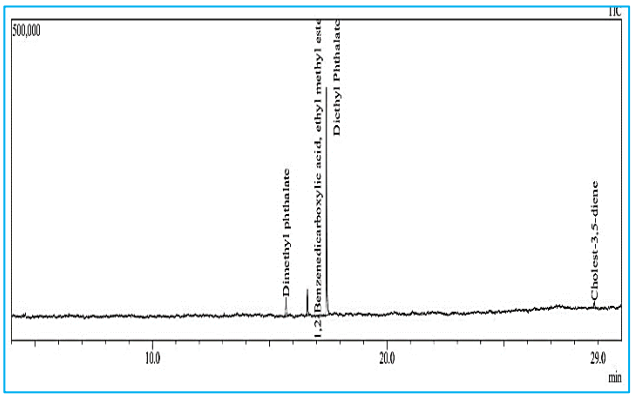

Fig 5 GC-MS analysis in of fenugreek plant in control

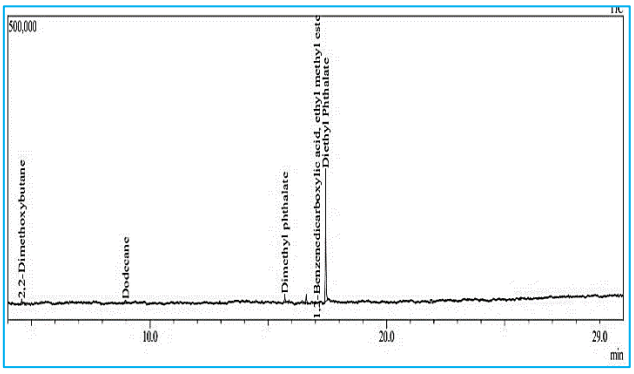

Fig 6 GC-MS analysis of fenugreek plant in soil: sand: vermicompost: cocopeat

The (Fig 5) shows the dimethyl phthalate, 1, 2 - Benzenedicarboxylic acid and Ethyl methyl ester, Diethyl phthalate and Cholest 3, 5 diene phytocompounds identified in control of fenugreek and Fig.6. Shows the 2, 2-Dimethoxybutane, Dodecane, Dimethyl Phthalate, 1, 2-Benzenedicarboxylic acid and Ethyl methyl ester, Diethyl phthalate phytocompounds identified in soil: sand: vermicompost: cocopeat of fenugreek. The Dimethyl phthalate is a phthalate ester, a diester and a methyl ester and it is simple compound of phthalate acid esters (PAEs) class. The dimethyl phthalate (PAEs) is present in vegetable soil is greater than agricultural soil [63]. The 1, 2- Benzenedicarboxylic acid is a phthalic acid and the compound nature of 1, 2-Benzenedicarboxylic acid is plastilizer compound and the 1, 2-Benzenedicarboxylic acid have anti-inflammatory and antiseborrheic activity [7], [18]. The Ethyl methyl ester is a chemical compound. The Diethyl phthalate is a phthalate ester and it is made from phenols and flavonoids substance and it is used for medicine of different diseases [33]. The Diethyl phthalate have antimicrobial and antibacterial activity and they are found to their many therapeutic activities like anti-inflammatory, anticancer, etc. [33]. The Cholest 3, 5 diene is a

cholestanoid. The 2, 2- Dimethoxybutane is chemical compound and it is the alkoxy derivatives of alkane and also have antidermatophytic activity [26]. The Dodecane is a straight – chain alkane with 12 carbon atoms.

Table 1 Height of the plants

Seeds	Germination days			Height (After 15 days)			Lab to land (After 15 days)			Next 15 days		Next 15 days		Next 15 days	
	Fenugreek	Bitter gourd	Chilli	Fenugreek	Bitter gourd	Chilli	Fenugreek	Bitter gourd	Chilli	Bitter gourd	Chilli	Bitter gourd	Chilli	Bitter gourd	Chilli
Soil	9	-	14	4.11±0.37	-	1.8375±0.78	5.0625±0.27	-	1.33±0.30	-	5.1±11.34	-	11±7.375	-	14±38.8
Sand	7	-	13	3.94±1.80	-	1.66±0.38	2±3.16	-	0.716±0.05	-	6.25±6.8125	-	11.4±1.54	-	13±15.6
Cocopeat	4	-	-	3±0.625	-	-	1.33±1.38	-	-	-	-	-	-	-	-
Vermicompost	6	-	10	3.8571±0.05	-	2.75±0.5	-	-	2.6875±0.74	-	6.916±3.3680	-	8.375±7.609375	-	9.75±5.1875
Soil: Sand	6	-	-	4.1875±0.55	-	-	4.25±1.56	-	-	-	-	-	-	-	-
Soil: Cocopeat	6	-	13	4.4375±0.77	-	2.7±0.41	-	-	-	-	-	-	-	-	-
Cocopeat: Vermicompost	4	-	11	4.33±0.5	-	2.375±0.54	-	-	2.6875±0.24	-	4.7857±0.8469	-	10.083±7.53472	-	17.667±11.22
Sand: Vermicompost	6	-	11	3.8±1.66	-	-	-	-	-	-	-	-	-	-	-
Soil: Vermicompost: Cocopeat	6	-	14	4.38±0.37	-	-	5.125±0.54	-	-	-	-	-	-	-	-
Soil: Sand: Vermicompost: Cocopeat	4	10	13	3.44±1.41	5.33±1.55	-	3.625±0.92	14.16 ± 1.38	-	38±0	-	97±0	-	100±0	-

The (Table 1) shows the height of fenugreek, bitter gourd and chilli. We using standard deviation calculator to calculate the height of plant. We measured height of fenugreek, bitter gourd and chilli after 15 days. The germination day of fenugreek in soil is 9th day and chilli are 14th day. In soil, the fenugreek height is 4.11±0.37 because nine plant height are calculated by nine (Total number of plants) and chilli height is 1.8375±0.78 because eight plant height are calculated by eight. In lab to land the fenugreek height is 5.0625±0.27 because eight plant height are calculated by eight and chilli height is 14±38.8 because the five-plant height is calculated by five. The germination day of fenugreek in sand is 7th day and chilli are 13th day. In sand, the fenugreek height is 3.94±1.80 because the nine-plant height are calculated by nine and chilli height is 1.66±0.38 because six plant height are calculated by six. In lab to land the fenugreek height is 2±3.16 because three plant height is calculated by three and chilli height is 13±15.6 because the five-plant height are calculated by five. The germination day of fenugreek in cocopeat is 4th day and chilli are not germinated. The germination day of fenugreek in vermicompost is 6th day and chilli are 10th day. In vermicompost, the fenugreek height is 3.8571±0.05 because seven plant height are calculated by seven and chilli height is 2.75±0.5 because eight plant height are calculated by eight. The germination day of fenugreek in soil: sand is 6th day and chilli are no germinated. The germination day of fenugreek in soil: cocopeat is 6th day and chilli are 13th day. In soil: cocopeat, the fenugreek height is 4.4375±0.55 because eight plant height are calculated by eight and chilli height is 2.7±0.41 because ten plant height are calculated by ten. The germination day of fenugreek in cocopeat: vermicompost is 4th day and chilli are 11th day. In cocopeat: vermicompost, fenugreek height is 4.33±0.5 because nine plant height are calculated by nine and chilli height is 2.375±0.54 because eight plant height are calculated by eight. The germination day of fenugreek in sand: vermicompost is 6th day and chilli are 11th day. The germination day of fenugreek in soil: vermicompost: cocopeat is 6th day and chilli are 14th day. The germination day of fenugreek in soil: sand: vermicompost: cocopeat is 4th day and bitter gourd is 10th day and chilli are 13th day. In soil: sand: vermicompost: cocopeat, the fenugreek height is 3.44±1.41 because nine plant height are calculated by nine and bitter gourd height is 5.33±1.55 because three plant height are calculated by three. In lab to land the fenugreek height is 3.625±0.92 because four plant height are calculated by four and bitter gourd height is 100±0 because three plant height are calculated by three. In our observation, the bitter gourd is only germinated in soil: sand: vermicompost: cocopeat. The cocopeat and soil: sand is not suitable for chilli. In our observation, the highest fenugreek plant height detected in soil and the lowest fenugreek plant height detected in cocopeat [3]. The highest bitter gourd plant height is detected in soil: sand: vermicompost: cocopeat only [61]. The highest chilli plant height detected in cocopeat: vermicompost and lowest chilli plant height detected in vermicompost [58].

The (Table 2-3) shows the presence of Dimethyl phthalate, 1, 2-Benzedicarboxylic acid and Ethyl methyl ester, Dimethyl phthalate, Cholest-3, 5- diene are these phytocompounds found in control and 2, 2- Dimethoxybutane, Dodecane, Dimethyl phthalate, 1, 2-Benzedicarboxylic acid and Ethyl methyl ester, Diethyl phthalate are these phytocompounds found in soil: sand: vermicompost: cocopeat of fenugreek and their results are shown in (Table 2) [12]. The detection of phytocompounds is depend on molecular weight and conical smile of each compound as compared to the NIST17 library of database and the information of therapeutic activities of phytocompound is done from Pubchem and it is shown in (Table 2-3) [12]. The conical smile is present below every phytocompound. Pa is the probability to be active estimates the chance that studied compound is belonging to the sub-class of active compounds. Pi is the probability to be inactive estimates the chance that the studied compound is belonging to the sub-class of inactive compounds. These phytocompounds broadly belong to 4-5 types of compounds such as Dimethyl phthalate, 1, 2-Benzedicarboxylic acid, Cholest-3, 5- diene, Ethyl methyl ester, etc. [42]. Present, the GC-MS studies of Fenugreek (*Trigonella foenum graceum*) 9 defined phytocompounds which have been identified for specific therapeutic activities [42]. The present study with, *Fenugreek* (*Trigonella foenum graceum*), described highest phytocompounds are used as a part of treatments to promote therapeutic activities like antidiabetic, antiseborrheic, antieczematic, antifungal, anti-inflammatory, hair growth stimulant etc. [21], [42].

Table 2 GC-MS identified phytocompounds of control and optimized compost grown plants

Phytocompounds	Mil Ogp	No. of H bond donor	No. of H bond acceptor	Molecular weight	Rotatable bond count	Pa	Pi	Therapeutic activity
Dimethyl phthalate, 2-propionyloxybenzoic acid, 2-propanoyloxybenzoic acid, Salicyclic acid, propionate CCC(=O)OC1=CC=CC=C1C(=O)O	1.7	1	4	194	4	0.892	0.005	Antiseborrheic activity
						0.897	0.007	Testosterone-17β-Dihydrogenase {$NADP^+$} inhibitor
						0.810	0.004	Fatty-Acyl-COA synthase inhibitor
						0.797	0.005	Lipoprotein lipase inhibitor
						0.786	0.022	Antieczematic activity
						0.582	0.007	Antidiabetic activity
1,2-Benzenedicarboxylic acid, Ethyl methyl ester , Ethyl 2-acetoxybenzoate, Ethyl acetylsalicyclate, Ethyl o-acetylsalicyclate, Ethyl 2-acetyloxybenzoate CCOC(=O)OC1=CC=CC=C1C(=O)O	1.6	0	4	208	5	0.936	0.003	Antiseborrheic activity
						0.914	0.003	Antipyretic activity
						0.865	0.004	Membrane permeability inhibitor
						0.754	0.010	Antiinflammatory activity
						0.740	0.009	Lipoprotein lipase inhibitor
						0.738	0.013	Prostaglandin-E2-9-reductase inhibitor
						0.688	0.050	Antieczematic activity
Diethyl phthalate, 1,4-phenylene dipropionate, 1,4-dipropionyloxybenzene, 1, 4-phenylene dipropanoate CCC(=O)OC1=CC=C(C=C1)OC(=O)CC	2.4	0	4	222	6	0.913	0.004	Antiseborrheic activity
						0.874	0.006	Sugar phosphate inhibitor
						0.863	0.012	Testosterone
						0.852	0.004	Dextranase inhibitor
						0.693	0.048	Antieczematic activity
						0.664	0.022	JAK2 expression inhibitor
						0.607	0.019	Alopecia treatment
						0.520	0.006	Urotoxicity activity
Cholest-3,5-diene, Cholesterilene, 3,5-cholestadiene, Cholesterylene CC(C)CCCC(C)C1CCC2C1(CCC3C2CC=C4C3(CCC=C4)C)C	9.8	0	0	368	5	0.788	0.010	Prostag
						0.781	0.030	Testosterone activity
						0.681	0.009	Dermatologic activity
						0.582	0.098	Membrane permeability inhibitor
						0.509	0.046	Lipoprotein lipase inhibitor
						0.490	0.011	Wound healing agent
						0.479	0.034	Antifungal activity
						0.287	0.004	Hair growth stimulant

Table 3 GC-MS identified in soil: sand: vermicompost: cocopeat and optimized compost of grown plants

Phytocompounds	Mil Ogp	No. of H bond donor	No. of H bond acceptor	Molecular weight	Rotatable bond count	Pa	Pi	Therapeutic activity
2,2-Dimethoxybutane, Hexanediol, Hexane-1,1-diol, Hexandiol CCCCCC(O)O	1.4	2	2	118	4	0.953	0.002	Sugar phosphatase inhibitor
						0.782	0.009	Antieczematic activity
						0.738	0.009	Lipoprotein lipase inhibitor
						0.720	0.005	N-acetylglucosaminyl transferase inhibitor
						0.615	0.010	Antipruatic activity
Dodecane,n-dodecane, Dihexyl, Bihexyl CCCCCCCCCCCC	6.1	0	0	170	9	0.954	0.002	Sugar phosphatase inhibitor
						0.914	0.005	Testosterone
						0.907	0.003	Dextranase inhibitor
						0.895	0.005	Antieczematic activity
						0.857	0.009	Antiseborrheic activity
						0.804	0.005	Lipoprotein lipase inhibitor
						0.769	0.004	Steroid N-acetylglucosaminyl
Dimethyl phthalate, 2-propionyloxybenzoic acid, 2-propanoyloxybenzoic acid, Salicyclic acid, Propionate COC1=C(C=CC(=C1)C=CC(=O)O)O	1.7	1	4	194	4	0.892	0.005	Antiseborrheic activity
						0.897	0.007	Testosterone-17β-Dihydrogenase {NADP+} inhibitor
						0.810	0.004	Fatty-Acyl-COA synthase inhibitor
						0.797	0.005	Lipoprotein lipase inhibitor
						0.786	0.022	Antieczematic activity
						0.582	0.007	Antidiabetic activity
1,2-Benzenedicarboxylic acid, Ethyl methyl ester, Ethyl 2-acetooxybenzonate, Ethyl acetyl salicyclate, Ethyl o-acetylsalicyclate, Ethyl 2-acetyloxybenzonate CCOC(=O)C1=CC=CC=C1OC(=O)C	1.6	0	4	208	5	0.936	0.003	Antiseborrheic activity
						0.914	0.003	Antipyretic activity
						0.865	0.004	Membrane permality inhibitor
						0.754	0.010	Antiinflammatory activity
						0.740	0.009	Lipoprotein lipase inhibitor
						0.738	0.013	Prostaglandin-E2-9-reductase inhibitor
						0.688	0.050	Antieczematic activity
						0.488	0.025	Antipsoriatic activity
						0.388	0.052	Antifungal activity
Diethyl phthalate, 1,4-phenylene, Dipropionate, 1,4-dipropionyl oxybenzene, 1,4-phenylene dipropanoate CCC(=O)OC1=CC=C(C=C1)OC(=O)CC	2.4	0	4	222	6	0.913	0.004	Antiseborrheic activity
						0.874	0.006	Sugar phosphate inhibitor
						0.863	0.012	Testosterone
						0.852	0.004	Dextranase inhibitor
						0.693	0.048	Antieczematic activity
						0.664	0.022	JAK2 expression inhibitor
						0.607	0.019	Alopecia treatment
						0.520	0.006	Urotoxicity activity

Table 4 Germination, flowering and fruiting days, survival rate of fenugreek and chilli

Seed sow	Germination days		Flowering days		Fruiting days		Total days required to cultivated		Survival rate		Total quantity	
	Fenugreek	Chilli	Fenugreek	Chilli	Fenugreek	Chilli	Fenugreek	Chilli	Fenugreek	Chilli	Fenugreek	Chilli
Soil	9	14	30	59	-	17	39	90	67.5	140	-	168gm
Sand	7	13	32	80	-	14	39	107	140	112	-	72gm
Cocopeat	4	-	35	-	-	-	39	-	126.6	-	-	-
Vermicompost	6	10	33	80	-	17	39	107	300	126.6	-	96gm
Soil: Sand	6	-	33	-	-	-	39	-	60	-	-	-
Soil: Cocopeat	6	13	33	77	-	17	39	107	20	280	-	150gm
Cocopeat: Vermicompost	4	11	35	79	-	17	39	107	20	110	-	144gm
Sand: Vermicompost	6	11	33	-	-	-	39	-	20	20	-	-
Soil: Vermicompost: Cocopeat	6	14	33	75	-	17	39	106	110	120	-	36gm
Soil: Sand: Vermicompost: Cocopeat	4	13	35	69	-	18	39	100	110	100	-	12gm

Table 5 Germination, flowering and fruiting days, survival rate of bitter gourd, lady's finger, brinjal and tomato

Seed sow	Germination days		Flowering days		Fruiting days		Total days required to cultivated		Survival rate		Total Quantity	
	Soil	Soil: sand: Vermi-compost : cocopeat	Soil	Soil: sand: Vermi-compost : cocopeat	Soil	Soil: sand: Vermi-compost : cocopeat	Soil	Soil: sand: Vermi-compost : cocopeat	Soil	Soil: sand: Vermi-compost : cocopeat	Soil	Soil: sand: Vermi-compost : cocopeat
Bitter gourd	-	10	-	40	-	30	-	80	-	-	-	-
Lady's finger	7	6	46	45	12	14	65	65	20	65	6gm	12gm
Brinjal	7	11	92	92	21	28	120	131	20	-	130gm	-
Tomato	10	5	42	47	79	57	131	109	20	111.42	36gm	1984gm

The (Table 4-5) shows the germination days, flowering days, fruiting days, total days, total survival rate and total quantity of fenugreek, bitter gourd, chilli, lady's finger, brinjal and tomato. The germination day of fenugreek in soil is 9th day and chilli is 14th day. The flowering day of fenugreek is 30 and chilli is 59 after 17 days fruiting of chilli. The total days of fenugreek is 1 month 9 days and chilli are 3 months. The survival rate of fenugreek is 67.5 and chilli is 140 and total quantity of chilli is 168gm. The germination day of fenugreek in sand is 7th day and chilli are 13th day. The flowering day of fenugreek is 32 and chilli is 80 after 14 days fruiting of chilli. The total days of fenugreek is 1 month 9 days and chilli is 3 month 17 days. The survival rate of fenugreek is 140 and chilli is 112 and total quantity of chilli is 72gm. The germination day of fenugreek in cocopeat is 4th day and chilli is not germinated. The flowering day of fenugreek is 35. The total days of fenugreek is 2 month 9 days. The survival rate of fenugreek is 126.6. The germination day of vermicompost is 6th day and chilli is 10th day. The flowering day of fenugreek is 33 and chilli is 80 after 17 days fruiting of chilli. The survival rate of fenugreek is 300 and chilli is 126.6 and total quantity of chilli is 96gm. The germination day of fenugreek in soil: sand is 6th day and chilli is not germinated. The flowering days of fenugreek is 33. The total days of fenugreek is 2 month 9 days. The survival rate of fenugreek is 60. The germination day of fenugreek in soil: cocopeat is 6th day and chilli is 13th day. The flowering days of fenugreek is 33 and 77 after 17 days fruiting of chilli. The total days of fenugreek is 1 month 9 days and chilli is 3 month 17 days. The survival rate of fenugreek is 20 and chilli is 280 and total quantity of chilli is 150gm. The germination day of fenugreek in cocopeat: vermicompost is 4th day and chilli is 11th day. The flowering days of fenugreek is 35 and chilli is 79 after 17 days fruiting of chilli. The total days of fenugreek is 1 month 9 days and chilli is 3 month 17 days. The survival rate of fenugreek is 20 and chilli is 110 and total quantity of chilli is 144gm. The germination day of fenugreek in sand: vermicompost is 6th day and chilli is 11th day. The flowering day of fenugreek is 33. The total days of fenugreek is 1 month 9 days. The survival rate of fenugreek is 20 and chilli is 20. The germination day of fenugreek in soil: vermicompost: cocopeat is 6th day and chilli is 14th day. The flowering day of fenugreek is 33 and chilli is 75 after 17 days fruiting of chilli. The total days of fenugreek is 1 month 9 days and chilli is 3 month 16 days. The survival rate of fenugreek is 110 and chilli is 120 and total quantity of chilli is 36gm. The germination day of fenugreek in soil: sand: vermicompost: cocopeat is 4th day and chilli is 13th day. The flowering day of fenugreek is 35 and chilli is 69 after 18 days fruiting of chilli. The total days of fenugreek is 1 month 9 days and chilli is 3 month 10 days. The survival rate of fenugreek is 110 and chilli is 100 and total quantity of chilli is 12gm. In our observation, the highest flowering days of fenugreek (35 days) are found in cocopeat and in cocopeat: vermicompost (35 days) and soil: sand: vermicompost: cocopeat (35 days) compost and lowest flowering days of fenugreek (30 days) are found in soil compost [3]. In our observation, the early flowering days of chilli (59 days) in soil and the late flowering days of chilli (80 days) in sand and vermicompost. The highest fruiting days of chilli (After flowering-18 days) are observed in soil: sand: vermicompost: cocopeat and the lowest fruiting days of chilli (After flowering-14 days) in sand compost. The highest total quantity of chilli (168gm) is observed in soil [59]. The germination day of bitter gourd in soil is not germinated and in soil: sand: vermicompost: cocopeat is 10th day. The flowering day of bitter gourd is 40 after 30 days fruiting of bitter gourd. The total days of bitter gourd is 2 month 20 days. The survival rate of bitter gourd is zero. In our observation, the highest flowering days of bitter gourd in soil: sand: vermicompost: cocopeat only. The germination day of lady's finger in soil is 7th day and in soil: sand: vermicompost: cocopeat is 6th day. The flowering day of lady's finger in soil is 46 after 12 days fruiting of lady's finger and in soil: sand: vermicompost: cocopeat is 45 after 14 days of fruiting of lady's finger. The total days of lady's finger in soil and soil: sand: vermicompost: cocopeat 2 month

5 days. The survival rate of lady's finger in soil is 20 and in soil: sand: vermicompost: cocopeat is 65 and total quantity in soil is 6gm and in soil: sand: vermicompost: cocopeat is 12gm. In our observation, the highest flowering days of lady's finger (46 days) are observed in soil and the lowest flowering days of lady's finger (45 days) are observed in soil: sand: vermicompost: cocopeat [52]. In our observation, the early fruiting days of lady's finger (12 days) in soil and the late fruiting days of lady's finger (14 days) in soil: sand: vermicompost: cocopeat. The highest total quantity of lady's finger (12gm) in soil: sand: vermicompost: cocopeat (40). The germination day of brinjal in soil is 7^{th} day and in soil: sand: vermicompost: cocopeat is 11^{th} day. The flowering day of brinjal in soil is 92 after 21 days fruiting of brinjal and in soil: sand: vermicompost: cocopeat is 92 after 28 days fruiting of brinjal. The total days of brinjal in soil is 4 month and in soil: sand: vermicompost: cocopeat is 4 month 11 days. The survival rate of brinjal in soil is 20 and total quantity of brinjal in soil is 130gm. In our observation, the flowering days of brinjal (92 days) are observed similar in both composts. In our observation, the highest fruiting days of brinjal (After flowering-28 days) and lowest fruiting days of brinjal (After flowering-21 days) in soil [40]. The highest total quantity of fruit of brinjal (130gm) are observed in soil [15]. The germination day of tomato in soil is 10^{th} day and in soil: sand: vermicompost: cocopeat is 5^{th} day. The flowering days of tomato in soil is 42 after 79 days fruiting of tomato and in soil: sand: vermicompost: cocopeat is 47 after 57 days fruiting of tomato. The total days of tomato in soil is 4 month 11 days and in soil: sand: vermicompost: cocopeat is 3 month 19 days. The survival rate of tomato in soil is 20 and in soil: sand: vermicompost: cocopeat is 111.42 and total quantity of tomato in soil is 36gm and in soil: sand: vermicompost: cocopeat is 1984gm. In our observation, the highest flowering days of tomato (47 days) are observed in soil: sand: vermicompost: cocopeat and the lowest flowering days of tomato (42 days) are observed in soil. The highest fruiting days of tomato (After flowering-79days) are observed in soil and the lowest fruiting days of tomato (After flowering-57 days) are observed in soil: sand: vermicompost: cocopeat. In our observation, the highest total quantity of tomato (1984gm) is found in soil: sand: vermicompost: cocopeat and the lowest total quantity of tomato (36gm) are found in soil [24]. In our observation, no germination of chilli in cocopeat and soil: sand. The (Table 5) shows the bitter gourd is germinated in soil: sand: vermicompost: cocopeat but not in soil. The (Table 4) shows the all compost are suitable for fenugreek. In our observation, the survival rate of fenugreek in vermicompost is higher than chilli and survival rate of chilli in soil: cocopeat is higher than fenugreek. In our result, the survival rate of bitter gourd and brinjal in soil is zero because their result is negative. The greatest survival rate is found in vermicompost of fenugreek and soil: cocopeat of chilli and soil: sand: vermicompost: cocopeat of lady's finger and tomato [38]. The soil: sand: vermicompost: cocopeat compost are suitable for lady's finger and tomato. The soil: cocopeat is most suitable compost for chilli because the survival rate of soil: cocopeat is higher than other compost and vermicompost is most suitable compost for fenugreek because the survival rate of vermicompost is higher than other compost. The soil: sand: vermicompost: cocopeat compost is suitable for bitter gourd and brinjal plant but not suitable for bitter gourd and brinjal fruits.

The (Fig 7) shows the bitter gourd result is negative because there is yellowish colour pigmentation so it does not show more favorability with this optimized compost and need to screen out further. Brinjal result is also negative because there is not sufficient nutrient provide to brinjal. The soil: sand: vermicompost: cocopeat composition are suitable for plant but not suitable for fruit.

Fig 7 A. Bitter gourd, B. Brinjal

Table 6 RF value of chilli analysis

Sample-chilli	RF Value	
	Standard value of control	Standard value of chilli sample
Glutamic acid	0.29	0.32
Aspartic acid	0.20	0.25
Arginine	0.18	0.22

The (Table 6) shows the sample of chilli in control by using thin layer chromatography. The thin layer chromatography is a useful technique for the separation and identification of compounds in the sample [5], [41]. The thin layer chromatography includes rapid balance among stationary and mobile phase [10]. The thin layer chromatography is low price, instant method [5], [10]. Thin layer chromatography is used to help find out purity of compound [5]. The adsorbent layer is called stationary phase [10]. In our observation, the standard value of control is 0.18 to 0.29 and the standard value of chilli sample are 0.22 to 0.32. In our result, the thin layer chromatography, the standard value of chilli sample is increased to lower standard value of control [10].

CONCLUSION

In the present study, fenugreek is antidiabetic, antiseborrheic, antieczememetic, antifungal anti-inflammatory and hair growth stimulant activity. Dimethyl phthalate, 1, 2-Benzedicarboxylic acid and Ethyl methyl ester, Dimethyl phthalate, Cholest-3, 5- diene are these phytocompounds found in control and 2, 2- Dimethoxybutane, Dodecane, Dimethyl phthalate, 1, 2-Benzedicarboxylic acid and Ethyl methyl ester, Diethyl phthalate are these phytocompounds found in soil: sand: vermicompost: cocopeat of fenugreek. Glutamic acid, aspartic acid and arginine these compounds are found in chilli sample. The GC-MS method is useful for detection of phytocompounds of fenugreek and thin layer chromatography is useful method for detection of compounds in chilli. Bitter gourd result is negative because there is yellowish colour pigmentation so it does not show more favourability with this optimized compost and need to screen out further. Brinjal result is also negative because there is not sufficient nutrient provide to brinjal. The Vermicompost is the most suitable compost for fenugreek because the survival rate of vermicompost is higher than other compost. The soil: cocopeat is the most suitable compost for chilli because the survival rate of soil: cocopeat is higher than other compost. The soil: sand: vermicompost:

cocopeat compost are suitable for lady's finger and tomato. The soil: sand: vermicompost: cocopeat compost is suitable for bitter gourd and brinjal plant but not suitable for bitter gourd and brinjal fruits.

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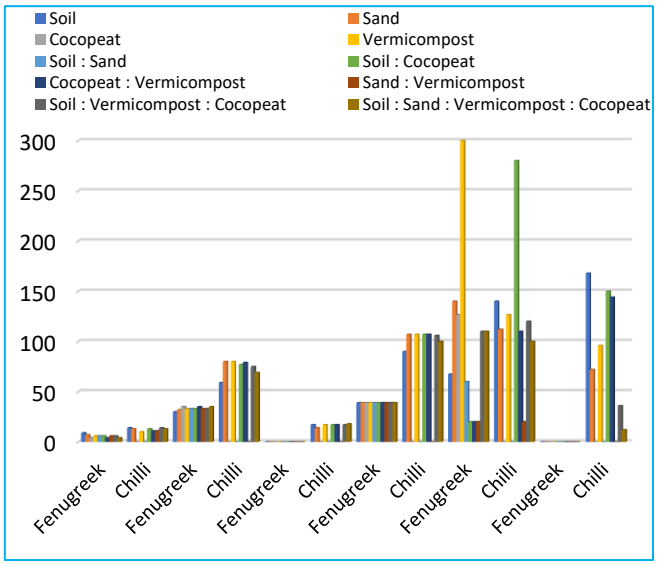
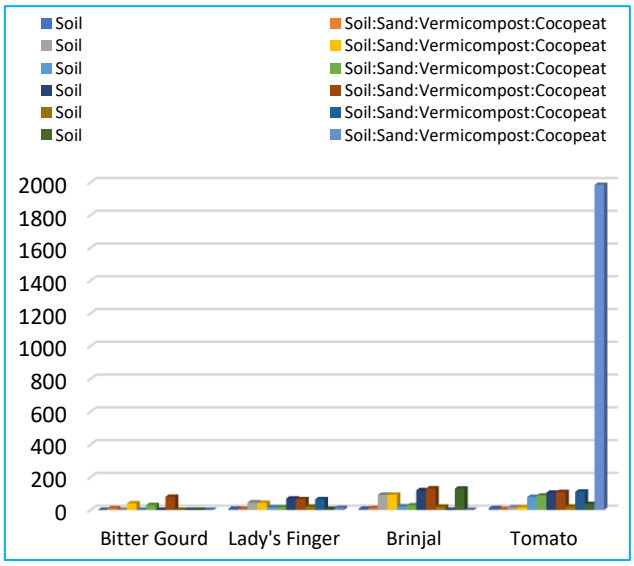


Graph 1 Total quantity of fenugreek and chilli



Graph 2 Total quantity of bitter gourd, lady's finger, brinjal & tomato

LITERATURE CITED

1. Ahirwar CS, Hussain A. 2015. Effect of vermicompost on growth, yield and quality of vegetable crops. *International Journal of Applied and Pure Science and Agriculture* 1: 49-56.
2. Aminifard M.H, Aroiee H, Fatemi H, Ameri A, Karimpour S. 2010. Responses of eggplant (*Solanum melongena* L.) to different rates of nitrogen under field conditions. *Journal of Central European Agriculture* 11(4): 453-458.
3. Anitha B, Reddy MLN, Dorajee Rao AVD, Kiran Patro TSKK, Salomi S. 2018. Study on growth and yield parameters in fenugreek. *International Journal of Pure and Applied Bioscience* 6(6): 469-475.
4. Awang Y, Shaharom AS, Rosali BM, Selamat A. 2009. Chemical and physical characteristics of cocopeat – based media mixtures and their effects on the growth and development of Celosia cristata. *American Journal of Agricultural and Biological Sciences* 4(1): 63-71.
5. Bele AA, Khale A. 2011. An overview on thin layer chromatography. *International Journal of Pharmaceutical Sciences and Research* 2(2): 256-267.
6. Benchasri S. 2012. Okara (*Abelmoschus esculentus* (L.) Moench) as a valuable vegetable of the world. *Ratarstvo i Povrtarstvo* 49: 105-112.
7. Beulah GGP, Soris PT, Mohan VR. 2018. GC-MS determination of bioactive compounds of *Dendrophthoe falcate* (L.F) Ettingsh: An Epiphytic Plant. *International Journal of Health Sciences and Research* 8(11): 261-269.
8. Bhatt JJ, Gajera HP, Dobariya DB, Trivedi MH. 2019. Residual pesticides analysis of various vegetables by GC-MS. *Research Journal of Life sciences, Bioinformatics, Pharmaceutical and Chemical Sciences* 5(1): 53.
9. Blouin M, Barrere J, Meyer N, Lartigue S, Barot S, Mathieu J. 2019 - Vermicompost significantly affects plant growth: A meta-analysis. *Agronomy for Sustainable Development* 39: 34.
10. Cai L. 2014. Thin layer chromatography. *Current Protocols*. DOI: 10.1002/9780470089941.et0603s08.
11. Chaidambaram V, Niraimathi L, Sudha V, Lavanya R, Vadivel V and Brindha P. 2015. Spectrophotometric, HPTLC and GC-MS studies on selected spice extracts. *International Journal of Pharmacy and Pharmaceutical Sciences* 7(6): 184-190.
12. Chaulagain A, Dhruva P, Gauchan, Lamicchane J. 2017. Vermicompost and its role in plants. *International Journal of Research* 4(8): 849-964.
13. Chowdhury MS, Hasan Z, Kabir K, Shah Jahan M, Kabir MH. 2014. Response of okra (*Abelmoschus esculentus* L.) to growth regulators and organic manures. *A Scientific Journal of Krishi Foundation* 12(2): 56-63.
14. Daman R, Singh KK, Singh B. 2016. Determination of micronutrients in vermicompost prepared with waste rose flower (Rosa berberia) collected from religious places of Patna. *Research Journal of Chemical and Environmental Sciences* 4(5): 37-43.
15. Das A, Pandit M.K, Pal S, Muthaiah K, Layek S. 2017. Characterization of brinjal genotypes for growth, yield and morphological traits. *Research Journal of Agricultural Sciences* 8(4): 789-796.
16. Dewi TK, Mubarok WZ, Antonius S. 2020. Study of plant growth promoting bacteria from coconut coir dust. *Article in T K Dewi et al 2020 IOP Conf.Ser, Earth and Environmental Science.* pp 439.
17. Elhag DE, Babekar SA, Ali I. 2017. Multi - residue analysis of organophosphorus pesticides in vegetables Using GC-MS. *Journal of Agricultural Chemistry and Environment* 6: 232-241.
18. Ezhilan BP, Ramasamy N. 2012. GC-MS analysis of phytocomponents in the ethanol extract of *Polygonum chinense* L. *Pharmacognosy Research* 4(1): 11-14.
19. Gadade SB, Shinde VS, Deosarkar DB, Shinde SS. 2017. Effect of plant growth regulators on growth and yield of Okra (*Abelmoschus esculentus* L.). *Plant Archives* 17(1): 177-180.

20. Geetha S, Sridhar KR, Sharma BB. 2020. Impact of vermicompost on the productivity of two edible legumes. *Jr. New Biol. Rep*. 9(2): 234-239.
21. Ghosh B, Chandra I, Chatterjee S. 2015. Fenugreek (*Trigonella foenum graecum* L.) and necessity. *Fire Journal of Engineering and Technology* 1(1): 60-67.
22. Ghoson SS. 2015. Chemical detection of some active compounds in eggplant (*Solanum melongena*) callus as compared with fruit and root contents. *International Journal of Current Microbiology and Applied Sciences* 4(5): 160-165.
23. Govindapillai SR, Patheri KK, Elumalai D, Mundarath PS, Vellaore NM. 2018. Effect of vermicompost and plant growth enhancers on the exo-morphological features of *Capsicum annum* (Linn.) Hepper. *International Journal of Recycling of Organic Waste in Agriculture* 7(4): 83-88. https://doi.org/10.1007/s40093-017-0191-5
24. Hossain MF, Ara N, Uddin MS, Islam MR, Kaisar MO. 2014. Effect of sowing dates of flowering, fruit setting and yield of tomato genotypes. *Journal of Agricultural Research* 52(4): 547-553.
25. Illanjiam S, Ramesh T. 2021. Effect of vermicompost on growth yield of selected organic vegetables. *International Journal for Research Trends and Innovation* 6(3): 11-14.
26. Ishak AH, Shafie NH, Norhaizan ME, Bahari H, Ismail A. 2018. From weed to medicinal plant: Antioxidant capacities and phytochemicals of various extracts of *Mikania micrantha*. *International Journal of Agriculture and Biology* 20(3): 561-568.
27. Jadid N, Maziyah R, Nurcahyani D.D, Mubarokah N.R. 2017 – Growth and physiological responses of some capsicum frutescens varieties to copper stress. *AIP Conference Proceedings* 1854(1): 020018.
28. Kachun L, Anne M, MacLeod JS, Tjepkema M, Peters PA, Demers PA. 2017. Cancer risks in a population – based study of 70,570 agricultural workers. Results from the Canadian Census health and Environment cohort (CanCHEC). *Kachuri et al. BMC Cancer* 17-343.
29. Kanthal LK, Dey A, Satyavathi K, Bhojaraju P. 2014. GC-MS analysis of bio-active compounds in methanolic extract of *Lactuca runcinata* DC. *Pharmacognosy Research* 6(1): 58-61. doi: 10.4103/0974-8490.122919.
30. Khaba CL, Luikham S, Devi CP, Singh NA, Chandam M, Roopa Kumar KSDS, Nath PD. 2020. Enhancing seed germination of king chilli (*Capsicum chinese* Jacq.) using pre-treatment solutions. *Journal of Pharmacognosy and Phytochemistry* 9(2): 334-338.
31. Khakimov B, Mongi RJ, Sorensen KM, Ndabikunze BK, Chove BE, Engelsen SB. 2016. A comprehensive and comparative GC-MS metabolomics study of non-volatiles in Taizanian grown mango, pineapple, jackfruit, baobab and tamarind fruits. *Food Chemistry* 213: 691-699. doi: 10.1016/j.foodchem.2016.07.005
32. Khan MF, Abutaha N, Nasr FA, Alqahtani AS, Noman OM, Wadaan MAM. 2019. Bitter gourd (*Momordica charantia*) possess developmental toxicity as revealed by screening the seeds and fruit extracts in zebrafish embryos. *Khan et al. BMC Complementary and Alternative Medicine.* pp 19-184.
33. Khanssa AS, Alsirraj MA, Allaith SA, Noori NA, Obaid MH, Mouhsan ZM, Swedan SS. 2018. The biological activities of seed extracts for fenugreek and black cumin and its inhibitory influences toward some pathogens. *Khanssa A. Shaheed et al.* ISSN 2521 - 8492; June.
34. Laczcano C, Dominguez J. 2011. The use of vermicompost in sustainable agriculture: impact on plant growth and soil fertility. Nova Science Publishers, Inc. ISBN 978-1-61324-785-3.
35. Lari SM, Abdossi V, Hassandokht M, Razmi J. 2014 - Evaluation effect of different levels of vermicompost and cocopeat on photosynthesis pigments in pepper (*Capsicum annum* L.). *Bulletin of Environment, Pharmacology and Life sciences.* 25-28.
36. Maity U, Dutta P, Layek B. 2016. Effect of plant growth regulators on growth, yield and quality of Okara (*Abelmoschus esculentus* (L.) Moench). *Journal of Agroecology and Natural Resource Management* 3(3): 251-253.
37. Makkar C, Singh J, Chander P. 2017. Vermicompost and vermiwash as supplement to improve seedling, plant growth and yield in *Linum usitassimum* L for organic culture. *Int. Jr. Recycl. Org. Waste Agriculture* 6: 203-218.
38. Marjenah, Kiswanto, Purwanti S, Sofyan. 2015. The effect of biochar, cocopeat and saw dust compost on the growth of two dipterocarps seedlings. *Nusantara Bioscience* 8(1): 39-44.
39. Mawiyah M, Rosazlin A, Yacob JS. 2018. Effect of vermicompost amendment on nutritional status of sandy loam soil, growth performance, yield of pineapple (*Ananas comosus* var. MD2) under field conditions. *Agronomy* 8(9): 183.
40. Meena VK, Dubey AK, Jain VK, Tiwari A, Negi P. 2017. Effect of plant growth promoters on flowering and fruiting attributes of okra [*Abelmoschus esculentus* (L.) Moench]. *Crop Research* 52(1/3): 37-40.
41. Mishra A, Nandi A. 2018. Correlation and path coefficient analysis for quality traits in tomato (*Solanum lycopersicon* L.). *Journal of Pharmacognosy and Phytochemistry* 7(1): 1733-1738.
42. Mishra DN, Gomare KS, Sheelwant SV. 2020. GC-MS analysis and phytochemical screening of *Indigofera tinctoria* (Linn.) leaf extract characterizing its medicinal use. *International Journal of Ayurvedic Medicine* 11(2): 289-299.
43. Mohammed FK, Kingimi M, Aminu D, Kajidu YB. 2019. Performance of parents and crosses for tomato (*Solanum lycopersicum* (L.) H. Karst) varieties resistance to root – knot nematode (*Meloidogyne spp*) in Sudan savannah of borno, state Nigeria. *Journal Arid Agriculture* 23: 50-55.
44. Mudiganti RK Rao, Sathish Kumar M, Jha NK. 2015. Comparative yield analysis of Chilli (*Capsicum annuum* L.) by application of vermicompost and panchagavya. *Journal of Chemical and Pharmaceutical Research* 7(9): 319-323.
45. Mukhtar FB. 2008. Effect of some plant growth regulators on the growth and nutritional value of *Hisbiscus subdariffa* L. (Red sorrel). *International Journal of pure and applied sciences. Int. Jor. P. App. Scs.* 2(3): 70-75.
46. Nair R, Pandey SK, Jyothsna J. 2021. Growth and yield of fenugreek (*Trigonella foenum graecum* L.) in response to different levels of phosphorus and biofertilizer (Rhizobium and PSB) under Kymore Plateau and Satpura Hill Agro-climatic zone of Madhya Pradesh. *The Pharma Innovation Journal* 10(1): 419-422.
47. Neelakantan N, Madanagopal N, de Souza RJ, Van Dam RM. 2014. The effect of fenugreek (*Trigonella foenum graecum* L.) intake on glycemia. A meta – analysis of clinical trials. *Nutritional Journal* 13: 7. doi: 10.1186/1475-2891-13-7.
48. Nisha, Pasaumarti BR. 2018. Gas chromatography – Mass spectrometry analysis for identification of bioactive compounds in selected genotypes of Trigonella foenum-graecum L. *The Pharma Innovation Journal* 7(4): 929-939.

49. Olaniyi JO, Akanbi WB, Akande OG. 2010. Growth, fruit yield and nutritional quality of tomato varieties. *African Journal of Food Science* 4(6): 398-402.
50. Pandey HK, Deendayal, Pandey V, Pant, Ahmed Z. 2010. Variation of capsaicinoids in chilli (*Capsicum frutescens* L.) cultivators with the maturity of fruits in middle hill conditions of western Himalayas. *International Journal of Green Pharmacy* 4(3): 178-182.
51. Priya G, Ranjith Kumar M, Vimalabangarusamy. 2021. Effect of vermicomposting by determining the plant growth rate in the mixture of polluted – vermicompost soil. *Journal of Xi'an University of Architecture and Technology* 13: 7. doi: 10.1186/1475-2891-13-7.
52. Rajappa MR, Padma M, Neeraja PB, Saidanaik D. 2020. Effect of growth regulators and pruning on growth and flowering of Okara (*Abelmoschus esculentus* L. Moench). *International Journal of Current Microbiology and Applied Sciences* 9(12): 330-343.
53. Sharma DP, Prajapati JL, Tiwari A. 2014. Effect of NPK, vermicompost and vermiwash on growth and yield of Okra. *International Journal of Basic and Applied Agricultural Research* 12(1): 5-8.
54. Sharmila D, Jeyanthi Rebecca L. 2021. Study of influence of vermicompost on the growth parameters of fenugreek (*Trigonella foenum graceum*) seeds. *Indian Journal of Advanced Botany* 1(1): 22-25.
55. Shubha AS, Devaraju, Sharavati MB, Srinivasa V, Kantharaj Y, Ravi CS, Angadi A, Yallesh Kumar HS, Shanwaz A. 2018. Medicinal and nutritional importance of bitter melon (*Momordica charantia* L). A review article. *Journal of Pharmacognosy and Phytochemistry* SP3: 297-300.
56. Sripontan Y, Hung MH, Young CC, Hwang SY. 2014. Effects of soil type and plant growth promoting microorganism on cabbage and *Spodoptera litura* performance. *Journal of Agriculture and Forestry* 63(3): 153-161.
57. Suparno, Prasetya B, Talkah A, Soemarno. 2017. The study of vermicomposting optimization of organic waste. *International Journal of Advanced Research* 5(3): 37-43.
58. Prradhiepan T, Seran TH, Hariharan G. 2018. Effect of integrated nutrient management on green pod yield of chilli (*Capsicum annum* L.) CV MIPC-01. *Sabaragamuwa University Journal* 16(1): 28-33.
59. Thakur G, Singh AK, Maurya PK, Patel P, Udit K. 2018. Effect of plant spacing on growth, flowering, fruiting and yield of Capsicum (*Capsicum annum* L) hybrid buffalo under natural ventilated polyhouse. *Journal of Pharmacognosy and Phytochemistry* SPI: 78-81.
60. Thuy PT, Nghia NTA, Dung PT. 2017. Effects of vermicompost levels on the growth and yield of HT152 tomato variety grown organically. *International Journal of Agriculture Innovations and Research* 5(4): 2319-1473.
61. Valyaie A, Azizi M, Kashi A, Sathasivam R, Park SU, Sugiyama, Motobayashi T and Fujii Y. 2021 – Evaluation of growth, yield and biochemical attributes of bitter gourd (*Momordica charantia* L.) cultivars under Karaj conditions in Iran. *Plants* 10(7): 1370.
62. Vijayalakshmi A and Gayathri V. 2017 – Effect of vermicompost on the growth and yield of chilli. *International Journal of recent scientific research.* Vol. 8. Issue 8. pp. 19540-19542.
63. Zhang Y, Zhang H, Sun X, Wang L, Du N, Tao Y, Sun G, Erinle KO, Wang P, Zhou C, Duan S. 2016. Effect of dimethyl phthalate (DMP) on germination, antioxidant system, and chloroplast ultrastructure in *Cucumis sativus* L. *Environmental Science Pollution Research* 23: 1183-1192.