INFLUENCE OF ORGANIC LEACHATES ON GROWTH AND YIELD OF BITTER GOURD

MD. MOZAMMAL HAQUE

DEPARTMENT OF HORTICULTURE
SHER-E-BANGLA AGRICULTURAL UNIVERSITY
DHAKA-1207

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BY

MD. MOZAMMAL HAQUE

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APPROVED BY:

Dr. A. F. M. Jamal Uddin	**Dr. Md. Ismail Hossain**
Professor	Professor
Department of Horticulture	Department of Horticulture
Dhaka-1207	Dhaka-1207
Supervisor	**Co-Supervisor**

Prof. Dr. Mohammad Humayun Kabir
Chairman
Examination Committee

Department of Horticulture
Sher-e-Bangla Agricultural University
Sher-e-Bangla Nagar, Dhaka-1207

Memo No.:

Dated:

CERTIFICATE

*This is to certify that the thesis entitled "**INFLUENCE OF ORGANIC LEACHATES ON GROWTH AND YIELD OF BITTER GOURD"** submitted to the Department of Horticulture, Sher-e-Bangla Agricultural University, Dhaka, in partial fulfillment of the requirements for the degree of **MASTERS OF SCIENCE** in **HORTICULTURE**, embodies the result of a piece of bona fide research work carried out by **MD.MOZAMMAL HAQUE**, Registration No. **11-04273** under my supervision and guidance. No part of the thesis has been submitted for any other degree or diploma.*

I further certify that any help or source of information, received during the course of this investigation has been duly acknowledged.

Dated: June, 2018
Dhaka, Bangladesh

Dr. A. F. M. Jamal Uddin
Professor
Department of Horticulture
Dhaka-1207

DEDICATED TO

MY

BELOVED PARENTS

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ABSTRACT

The experiment was conducted at Horticulture Farm, Sher-e-Bangla Agricultural University, Dhaka, during the period from Feb - July 2017, to study the influence of organic leachates on growth and yield of bitter gourd. Three treatments *viz*. BARI fertilizer dose (basal) used as control (T_1) BARI fertilizer dose (basal) + cowdung leachate as top dressing (T_2), BARI fertilizer dose (basal) + vermicompost leachate as topdressing (T_3) were studied in this experiment. These treatments were arranged in Randomized Complete Block Design with three replications. Significant variation was observed at different growth and yield parameters of bitter gourd with different treatments. Maximum plant height (2.85m), leaf number per plant (17.33), number of branch per plant (12.88), number of flower per plant (37.11), fruit number per plant (19.00), fruit weight (94.72 g), yield/plant (1.68 kg) and total yield (9.89 t/ha) were found from T_3 whereas minimum plant height (2.75m), leaf number per plant (11.88), number of branch per plant (9.55), number of flower per plant (30.22), fruit number per plant (14.33), fruit weight (76.37g), yield/plant (1.056 kg) and total yield (6.38 t/ha) from T_1 treatment (control). This study suggests that T_3 treatment acts as a potential source of plant nutrients for suitable bitter gourd production.

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ABBREVIATIONS AND ACRONYMS

SAU	Sher-e-Bangla Agricultural University
SAURES	Sher-e-Bangla Agricultural University Research System
SG	SAU Germplasm
CD	Cowdung
PM	Poultry Manure
VC	Vermicompost
CF	Chemical Fertilizer
FYM	Farmyard Manure
FCD	Farm Cowdung
AEZ	Agro-Ecological Zone
ANOVA	Analysis of Variance
df	Degrees of freedom
CV(%)	Percentage of Coefficient of Variation
FAO	Food and Agriculture Organization
LSD	Least Significant Difference
pH	Negative logarithm of hydrogen ions concentration
EC	Electrical Conductivity
MSTATC	Computer based statistical software package

CHAPTER I
INTRODUCTION

Bitter gourd (*Momordica charantia*), locally known as "Korolla" English bitter gourd, bitter cucumber, balsam pear. Bitter gourd or Momordica charantia gets its name from the Latin word "momordica", which means "to bite", referring to the grooved edges of its seed which looks as if it has been chewed. It is a member of the gourd family (e.g., squash, cucumbers). Actually, bitter gourd looks somewhat like a cucumber with lots of warts. Bitter gourd originated in the Old World, and was first domesticated in eastern India and southern China (Salunkhe *et al*., 1987).. It is believed that the slave trade brought bitter gourd from Africa to Brazil, and that seed dispersal by birds is responsible for its spread within continents. Wild and cultivated forms are now widespread throughout the tropics. Bitterness is attributed to nontoxic alkaloid momordicine. It is one of the most popular summer vegetables.

Bitter gourd occupies a prominent position amongst the various gourds cultivated in Bangladesh. In our country 57386 MT Bitter gourd produced in 26250 acres of land (BBS, 2017). It is grown all over the country but northen region specific in rajshahi division is the most bitter gourd producing area of the country. It ranks first among the cucurbits in respect of iron and vitamin C content (Araujo *et al.,* 2013),. The fruit has wormicidal properties and extracts are used to cure rheumatism (Indira, 1981). It is a blood purifier, activates spleen and liver and is highly beneficial in diabetes. It is a purgative, appetizer, digestive, anti-inflammatory and has healing capacity. It's fruits have high nutritive value and are relatively inexpensive source of protein, minerals and vitamins. The fruit is utilized in the preparation of pickles and also stored as a dry vegetable. Bitter gourd has been used for a long time in various Asian and African traditional medicines (Paul and Raychaudhuri, 2010).

Bitter gourd is used as a cooked vegetable. Bitter gourd fruit contains 70.4 g moisture, 1.6 g protein, 1.7 g fibre, 4.7 g carbohydrates, 20 mg calcium, 20 mg phosphorus, 1.8 mg iron and 88 mg vitamin C per100 g of edible portion (Gopalan et al., 1982) Among the various vegetables grown in Bangladesh, bitter gourd has prominent place in the diet as a rich source of vitamin, carbohydrates and minerals. Among the cucurbits it has special value for vitamin C content. It is also used in some of the medicinal preparations (Jeffery, 1983).

Production of bitter gourd is increasing day by day. Growth and production of the crop is governed by their genetic makeup and by environmental factors in which they grow. Yield and quality of vegetable crops depend upon many factor such as variety, climatic conditions, cultural practices, soil, nutrition and incidence of pest and diseases. Nutrient management plays an important role to boost up the yield of any vegetable crop. These nutrients can be supplied in organic or in inorganic source. In conventional agriculture, heavy doses of inorganic fertilizers are often used to improve the yield of Bitter gourd to meet up the increasing higher demand. Inorganic fertilizers have highly nutrient contents and are rapidly taken up by plants. However, the use of excess fertilizer can result in a number of problems, such as nutrient loss, surface water and ground water pollution, soil acidification or basification, reductions in useful microbial communities, and increased sensitivity to harmful insects. In addition, usage of inorganic fertilizer causes health hazard to the person who handle it. Moreover, inorganic fertilizers are relatively expensive that they are out of reach of small and marginal farmers. In this regard, to reduce and eliminate the adverse effects of chemical fertilizers, new agricultural practices have been developed in the so-called organic agriculture, ecological agriculture or sustainable agriculture. As the mode of release of essential nutrients from organic fertilizer is quite slow, suitable substitute or technique to improve the efficacy is required. Use of organic leachate from the same sources can be the answer. The application of organic leachate from cowdung, vermicompost result in higher growth, yield and quality of Bitter gourd.

They supplies essential macro and micro nutrients, many vitamins, essential amino acids, growth promoting substances like IAA, GA and beneficial microorganisms (Palekar, 2006). Overall, application of organic leachate in crop production is a new technique in Bangladesh and in case of bitter production it would be promising one through inorganic fertilizer use.

Keeping above points in view, present investigation has been undertaken with the objective:

- To study the effect of organic leachates on growth and yield of bitter gourd.

CHAPTER II

REVIEW OF LITERATURE

Bitter gourd is one of the most frequently consumed vegetable around the world as well as in Bangladesh. A wide range of cultivars present in Bangladesh. Consumer interest for Organic Fruits and vegetables are rising from last several consecutive decades. Some of significant research work which have been done in home or abroad related to this experiment have been presented (yearly wise) in this chapter.

Rekha and Gopalakrishnan (2001) steered a field experiment with bitter gourd *(Momordica charantia* L.) cv. Preethi in Thrissur. Kerala. India during kharif , 1999. Considering the total yield, marketable yield and size of fruits, the treatment T_7 which received a basal application of 20 tones dry Cowdung, 2.5 tones poultry manure, fortnightly drenching of 2.5 tones cowdung and a fertilizer dose of 70:25:25 kg NPK/ha was found superior to all other treatments. More or less equivalent fruit yield and fruit size were also recorded in T_5, which received same manures but absence inorganic fertilizers. This was noticeably presented the possibility of achieving a reasonably good yield by basal application of dry cowdung, top dressing with poultry manure and by drenching cowdung slurry at fortnightly intermission.

Isaac and Pushpakumari (1997) conducted a Held experiment at Department of Agronomy, College of Agriculture, Vellayani, India in 1994-95, where okras were grown with 6 t/ha FYM + chemical fertilizers and 12 t/ha FYM + chemical fertilizers or vermicompost or poultry manure. The effect of picking no, 2, 4 or 6 green fruits/plant was also determined. Fruit and seed yields were highest with FYM + chemical fertilizers, but there was only a marginal benefit in applying the higher rate of FYM. Seed yield reduce as more fruits were picked.

Subbaiah *et al*. (1985) conducted an trial with tomato and bitter gourd to evaluate the effect of FYM and micronutrients lower than soil fertility status. The author determined that the main object for extended mean fruit weight and fruit yield by the application of FYM with NPK and vermicompost was attributed to solubilization effect of plant nutrients by the addition of vermicompost and FYM leading to highly uptake of NPK.

In a study, Nair *et al*. (1997) compared the microorganisms associated with vermicomposts with those in conventional composts. They establish that the vermicomposts had much larger populations of bacteria (5.7 x 107), fungi (22.7 x 104) and actinomycetes (17.7 x 106) compared with those in traditioonal composts. The outstanding physiochemical and biological attributies of vermicomposts make them excellent ingredients as additives to greenhouse container media, organic fertilizers or soil amendments for horticultural crops. A large beneficial microbial population and biologically active metabolites, specefic gibberellins, cytokinins, auxins and B vitamins were experimental with application of vermicompost alone or in combination with organic or chemical fertilizers, so as to get better yield and quality of diverse crops (Tomati *et al*., 1983; Bano and Kale, 1987 and Bhawalker, 1991).

Vermicomposting is a bio-oxidation and stabilization methods of organic material that associated the joint action of earthworms and microorganisms. The earthworms are the agents which help for turning, fragmentation and aeration. It also increase N_2 fixation by both nodular and free living N_2 fixing bacteria and thus increase plant growth. Vermicompost has been demonstrated as one of the cheapest source of nitrogen and other essential elements for better nodule formation and yield particularly in legumes. Such plants can meet up their N needs through both biological nitrogen fixation (symbiosis) and native nitrogen in the soil (Parthasarthi and Ranganathan, 2002).

Arancon *et al.* (2004) applied organic fertilizer produced commercially from cattle manure, market food waste and recycled paper waste to tomatoes *(Lycopersicon esculentum),* bell peppers *(Capsicum anuumgrossum),* and strawberries (*Fragaria* spp.). The result revealed that the marketable tomato yields in all vermicompost-treated trial were consistently better than yields from the inorganic fertilizer-treated plots. Leaf areas, numbers of strawberry suckers, numbers of flowers, shoot weight and total marketable strawberry yields increased considerably in plots treated with vermicompost compared to those that received chemical fertilizers only besides significant increases in shoot, leaf areas and total and marketable fruit yields of pepper plants from plots treated with vermicomposts. The author indicate that improvement in plant growth and increases in fruit yield could be due to large proliferations in soil microbial biomass after vermicompost applications, leading to production of microbial hormones or humates in the vermicompost acting as plant-growth regulators independent of nutrient supply.

According to Nagavallemma *et al.* (2004) Vermicompost provides all nutrients. In readily available form and also increase uptake of nutrients by plants. Earthworms consume various organic wastes and reduce the volume by 40–60%. Each earthworm weighs about 0.5 g to 0.6 g eats waste equivalent to its body weight and produces cast equivalent to about 50% of the waste it consumes in per day. These worm castings have been examined for chemical and biological properties. The moisture content of castings ranges between 32% and 66% and the pH is around 7.0. The worm castings contain higher percentage of both macro and micronutrients than the garden compost. Soil available N increased significantly with increasing levels of vermicompost and highest quantity of N uptake was obtained at 50% of the recommended fertilizer rate plus 10 t ha^{-1} vermicompost. Vermicompost reduces C:N ratio and retains more nitrogen. The prolonged immobilization of soil nitrogen by the vermicomposted organic manures was attributed to the recalcitrant nature of its C and N composition. It proliferations macro pore space ranging from 60

to 500 μm, resulting in increased air-water relationship in the soil which favorably affects plant growth and development. The application of vermicompost favorably affects soil pH, microbial population and soil enzyme activities .

Kannan *et al*. (2006) examined that application of recommended quantities of vermicompost to different field crops has been stated to decline the requirement of chemical fertilizers without affecting the crop yield. Application of 100% nitrogen as vermicompost enumerated the increase plant height and number of branches per plant of tomato and it was significantly superior over supplementation of 100% N through urea and FYM alike trend was found in most plant height of basmati rice at maturity with the application of vermicompost and it was on par with treatment receiving azolla at the rate 1.5 ton/ha. A progressive advance in plant height and leaf area key of soybean was observed with the conjunctive use of 75% N through vermicompost and remaining 25% N through inorganic fertilizer and was originate at par with 100% N through vermicompost alone. Additive benefit determined from vermicompost submission (Govindan and Thirumurugan, 2005) might be attributed to its higher nutrient substances and their availability to crop.

Vermicompost applications in strawberries can progress helpful microbial populations, which rise production of plant growth hormones auxin, gibberellin, cytokinin and humic acid. Several experiments in strawberry have designated that these hormones and acids may develope plant growth, leaf area, shoot biomass, number of flowers and runners (Arancon *et al.*, 2004) and yield (Arancon *et al*., 2004; Singh *et al*., 2008). According to Arancon *et al*. (2006) vermicompost uses are recognized to improve microbial biomass N and protect fruit marketability through reduction in physiological disorders and fruit disease.

Federico *et al*. (2007) implemented an experiment to determine growth, productivity and chemical physical characteristics of tomatoes (*Lycopersicum esculentum*) in a greenhouse condition. Five treatments were given combining vermicompost and soil in proportions of 0:1, 1:1, 1:2, 1:3, 1:4 and 1:5 (v/v). Supplimentation of vermicompost improved plant heights significantly, but had no significant effect on the numbers of leaves or yields 90 days after transplanting. Yield of tomatoes were considerably greater when the relationship of vermicompost:soil was 1:1, 1:2 or 1:3, 95 days after transplanting. Addition of sheep-manure vermicompost reduce soil pH, titratable acidity and amplified solubility and insoluble solids in tomato fruits paralleled to those harvested from plants cultivated in unlamented soil. Sheep-manure vermicompost as a soil supplement improve tomato yields and soluble, insoluble solids and carbohydrate concentration

Manatad and Jaquias (2008) experimented growth and yield performance of vegetables as influenced by the application of dissimilar rates of vermicompost. Data on plant height, number of fruits/plant, length of fruits, diameter of fruits, fruits weight/plant and yield were gathered and analyzed. Findings of the study exposed the following: Inorganic analysis of vermicompost used in the experiment has 26.32% organic matter (DM); 2.09% N; 2.57% P; 0.44% K; 1.04% Ca; 0.45% Mg; 73.50 ppm Cu; 115.75 ppm Zn; 1055 ppm Mn; and 3257.5 ppm Fe. It has a pH of 6.9. In bitter gourd, fruit length, diameter, weight of fruits/plant and yield were considerably influenced by vermicompost application except for the length of vines and number of fruits. In eggplant, all parameters were markedly prejudiced by the application of the different rates of vermicompost except for the fruit length and diameter. In tomatoes, different rates of vermicompost generated significant difference on the fruit length and diameter, weight of fruits and fruit yield. In sweet pepper, all parameters highly increased, regardless of the amount of vermicompost applied. Ther application of vermicompost significantly reduced the severity of bacterial wilt incidence

in sweet pepper while in eggplant and tomatoes pollution was slightly decreaced by statistically comparable in all treatments.

Rasool *et al*. (2008) obtained that vermicompost at rate of 15 t/ha significantly improve growth, yield of bitter gourd compared to other treatments (0, 5, 10 t/ha). It also increased EC of fruit juice and percentage of fruit dry matter up to 30 and 24%, respectively. The content of K, P, Fe and Zn in the plant tissue increased 55, 73, 32 and 36% relate to untreated plot respectively.

A study was accomplished by Thirumaran *et al*. (2009) to estimate the effect of Seaweed Liquid Fertilizer of *Rosenvi geaintricata* with or without inorganic fertilizer on seed germination, growth, yield, pigment content and soil profile of *Abelmoschus esculentus.* From his study it is clear that 20% SLF with or without chemical fertilizer showing the higher growth, yield, chlorophyll pigment and soil profile compared to other concentration. Rakesh and Adarsh (2010) reported that soil and 45% cowdung + vermicompost increase various growth and yield parameters of tomato like mean stem diameter, mean plant height, yield/plant, marketable yield/plant, mean leaf number, total plant biomass were estimate for each treatment. The efficacy of Seaweed leachate of different concentrations obtained from green seaweed *Ulva lactuca* was attributed on the growth, pigments, total chlorophyll,m total protein, total carbohydrate and total lipid and the yield of a flowering plant *Tageteserecta*. The mutual effect of 1.0% SLF of *U. lactuca* with different proportions of recommended rate of chemical fertilizers was also made on the test plant. Among the concentrations, plants that received 1.0% SLF and 50% recommended rate of inorganic fertilizers showed a extreme growth characteristic, total number of flower and fresh weight of flowers (Sridharand Rengasamy, 2010)

The pot trial were carried out by Deore *et al*. (2010) with five doses (1% - 5%) of novel organic leachate along with untreated control plants. Observation of

growth show of capsicum revealed the consistent and significant results due to application of novel organic liquid fertilizer. Out of five different treatments, the 3% treatment resulted in extreme plant height; number of branches per plant; leaf number; leaf area; fresh and dry weight of the plant; number of fruits per plant and total yield associated to other doses. Though organic fertilizers release nutrients slowly than mineral fertilizer results in decreased S and P concentration in plants leaves, which in turn limits growth and yield. However, leachates treatment easily entrances their nutrient composition for the plants. Nileema and Sreenivasa (2010) evaluated the influence of liquid organic manures *viz.*, panchagavya, jeevamruth and beejamruth on the growth, nutrient content and yield of tomato in the sterilized soil. Significantly highest plant growth and root length was verified with the application of RDF + Beejamruth+Jeevamruth+Panchagavya and it was found to be significantly superior over other treatments. The application of Beejamruth+ Jeevamruth + Panchagavya was next best treatment and resulted in significantly maximum yield as compared to RDF alone. The N, P and K concentration of plants was significantly highest in the treatment given RDF + Beejamruth + Jeevamruth + Panchagavya.

Vermicompost is a very important biofertilizer produced through the artificial cultivation of worms i.e., vermiculture. Vermicompost is enriched with all beneficial soil bacteria and also contain many of the essential plant nutrients like N, P, K and micronutrients. It increases soil aeration, texture and tilt. Plant grown in vermicompost pretreated soil showed maximum increase in all morphological parameters such as root length, shoot length, number of root branches, number of stem branches, number of leaves, number of flowers, number of pods and number of root nodules in four months sampling in comparison to untreated, FYM treated and DAP treated soils in *Pisum sp.* And *Cicer sp.* (Sinha *et al.*, 2010). Furthermore, in vermicompost pretreated diversity indices (1.6 and 0.99 and 2.0 and 0.99 for *Cicer sp.* and *Pisum sp.*

respectively) than FYM, DAP and untreated control.soil, number of N_2 fixing bacterial colony were maximum and showed highest.

An experiment was carried out to control the effects of vermicompost on growth and productivity of cymbidium plants (*Cymbidium* sp.). Cymbidium was grown in a container medium including 50% pumice, 30% charcoal, 10% vermiculite and 10% peat moss, which was basic plant growth medium substituted with 10%, 20%, 30% and 40% (by volume) vermicompost besides control comprised of container medium alone without vermicompost. Greatest vegetative growth was noted from substitution of container medium with 30% and 40% vermicompost and lowest growth was in potting mixtures containing 0% vermicompost. Most flower buds and inflorescences arose in potting mixture containing 30% and 40% vermicompost and also causes most and greatest number of flower, greatest length of inflorescences in 30% vermicompost. Some of cymbidium growth and productivity enhancement, resulting from substitution of container medium with vermicompost, may be described by nutritional factors; however, other factors, such as plant-growth regulators and humus might have also been involved since all plants were, supplied regularly with all essential nutrients (Hatamzadeh and Masouleh, 2011).

Uddin *et al.* (2015) stated the performance of strawberry as affected by different organic manure. The experiment was conducted with 13 treatments and 3 replications. The treatment T4 (RDF + Vermicompost 5 t/ha + Neem Cake 4 t/ha) was found significantly superior compared to other treatment combinations, which recorded highest mean value of plant height (21.20cm), plant spread (26.62 cm2), number of leaves per plant (16.23), petiole length (13.93cm), number of fruits per plant (4.20) and average fruit weight (19.51g). The highest yield per plant (286.56g) and yield per hectare (17.19 t/ha) were also obtained from treatment T4 (RDF + Vermicompost 5 t/ha + Neem Cake 4

t/ha) followed by T_3 (RDF + Vermicompost 5 t/ha + Neem Cake 2 t/ha) and lowermost yield was obtained from T_0 (control).

Okra fruit production can be alternatively supported with application of organic manures, to decrease the use of chemical fertilizers. Experiments were conducted to assess the growth and yield of okra (Variety: NH47-4) with cowdung (CD) and poultry manure (PM). Plants were generally taller at 6 and 8 weeks after planting (WAP) with PM and CD. Application of the treatments delivered the tallest plants of 34 cm with CD and 83 cm with PM at 8 WAP. Okra pod yields were lower with PM relative to CD. 10 tha-1 PM gave the highest yield of 640 kg ha-1while the highest of 1297 kg ha-1, with 15 t ha-1 was got with CD.Poultry manure supports more of vegetative growth of okra while cowdung gives advanced fruit yields have been traced by Makinde and Ayoola (2012).

An experiment was executed by Lamo *et al*. (2012) to find the effect of diverse organic nutrient sources on seed quality and yield characters of radish. 13 treatments consist of bio-fertilizers, organic manures, control (no treatment) and inorganic were used. The interpretations were recorded on pod length (cm), number of seeds per pod, seed yield per plant and per plot (g), 1000-seed weight (g), seed germination (%) and vigor index. Analysis of variance exposed highly significant differences among treatments. Among all organic manures vermicompost was found comparatively better.

An investigation was accomplished by Attarde *et al.* (2012) on growth and nutrient status of *Abelmoschus esculentus*(okra plant). Various combinations of fertilizers such as Vermicompost (VC), Chemical Fertilizer (CF) and Farmyard Manure (FYM) were applied by followings, T1: Control, T2: (FYM 100%), T3: (VC 100%), T4: (CF 100%), T5: (VC 75% + CF 25%), T6: (VC 75% + FYM 25%), T7: (VC 50% +FYM 50%) and T8: (VC 50% + CF 50%). The study showed that that with the use of inorganic fertilizers plants physical characteristics were enhanced compared to other treatments whereas nutrient

status of okra fruit was recorded maximum in treatment T_3 (VC 100%) and followed by T_6 (VC 75% + FYM 25%). Although, treatment T_4 has exposed high potential for rapid growth of plant comparatively analogous results in the growth of plant were observed in treatment T_5 (VC 75% + CF 25%). Thus combination of organic fertilizer along with inorganic fertilizer is beneficial for the physical growth of okra plant while nutrient content of okra fruit are reliant only organic fertilizer dose.

The potential of vermicompost was investigated as one of the substrate constituent on yield catalogs of three strawberry cultivars. For this, four substrates consisted of (0%, 5%, 15% and 25% vermicompost indicated by S1, S2, S3 and S4 respectively) and three cultivars (Camarosa, Mrak and Selva) were used. The results of the experiment showed that highest of diameter of crown, fruit length and yield were found in interaction of Mrak and S2 (19.45 mm, 4.47 cm and 264.143 g respectively). The interaction of Selva and S3 had more fruit number (26.63) than other treatments. Selva cultivar in S4 had the highest of mean of fruit weight (12.33 g) also Mrak in S4 had 44 more number of inflorescence than further treatments. Camarosa in S1 had lower fruit length (2.66 cm) and mean of fruit weight (8.27 g) than other treatments also Selva in this substrate had the lowest of yield (140.79 g). The lowest of inflorescence number was detected in interaction of Camarosa and S3. Selva in S4 had the lowest of new diameter crown (13.47 mm) and fruit number (13.34 g) (Atefe *et al.,* 2012).

An experiment was carried out by Lamo *et al*. (2012) to find the effect of different organic nutrient sources on seed quality and yield characters of radish. Thirteen treatments involving of organic manures, bio-fertilizers, inorganic and control (no treatment) were used. The observations were recorded on pod length (cm), number of seeds per pod, seed yield per plant and per plot (g), 1000-seed weight (g), seed germination (%) and vigor index. Analysis of variance indicated highly significant difference among treatments. Among

organic manures vermicompost was set up comparatively better. The experiment was undertaken to survey the effect of growth regulator (Ripen-15) and fertilizer management practices on the growth, flowering and yield of bitter gourd *(Momordica charantia* L.)

Hibiscus esculentus was allowed to products in the medium of vermicompost and urea to evaluate the effect of vermicompost and urea on the growth and yield. There were 3 treatments viz., control, vermicompost (T1) and urea (T2). The germination percentage, shoot length and yield of the plant were noted on 20th, 40th and 60th days. From the study, maximum plant height (19.8 ± 2.9 cm), number of flower (21.3±0.36), number of fruit (15.0), fruit weight (10.3 g), total fruit weight (185.0 g) and fruit length (12.3 cm) was experimental from application of vermicompost on *Hibiscus esculentus*. This study revealed that vermicompost seems to be maintained the soil which is ideal for growth of the plant. The highest yield of *Hibsiscu esculentus* was found in vermicompost treatment (T1) followed by urea (T2) and lowest in control. Application of vermicompost increased the vegetative growth and yield of *Hibiscus esculentus* (Vanmathi and Selvakumari, 2012).

Mehdizadeh *et al*. (2013) conducted an experiment to evaluation the vegetative growth yield quantity of tomatoes as affected by different organic fertilizers. The results showed that adding of organic fertilizers at rate of 20 ton ha-1 significantly increased tomato growth and yield compared to control (no fertilizer application). Also obtained results demonstrated that tested treatments could be arranged in decreasing order as follows: municipal waste compost>poultry manure>cow manure>sheep manure>no fertilizer. Compost and poultry manure had a synergistic effect on both fresh and dry weights of tomato shoots and roots and related to other treatments. As a general result using of organic fertilizers especially in composted form had positive effect on soil health and fertility, which consequent proliferation yield in long term can be expected.

The best feature lettuce is assured by adequate fertilizing, steady supply of water and cool temperature. Most of the farmers are using inorganic fertilizers for lettuce in open fields and in hydroponics. However, there is an growing demand for organically produced fruits and vegetables. Peiris *et al*. (2015) found fresh weight in T3 (Glliricidia leaf extract) where the average EC and average pH were maintained at 0.43 dS/m and 5.85, respectively throughout the growing period. The maximum NL and *LA* were also found in T3, resulting a higher production of photosynthetic tissues; where the lowest *NL* and *LA* were experiential in T1 (Compost tea liquid). The highest *DW,* partitioned to leaves (*LDW*) and roots (*RDW*) were noted in T3. T1 and T2 (Poultry manure liquid) showed significantly lower dry matter partition to leaves and roots even though the highest EC (0.77dS/m) during the study period was noted in T2 The study revealed that *Glliricidia* leaf extract as the most favorable organic based liquid fertilizer for best growth show of leaf lettuce while Compost tea liquid was the lowest. Poultry manure was an intermediate performer in case of vegetative growth in leaf lettuce.

Pot experiment was accompanied by Kumar *et al*. (2015) to evaluate the effect organic manure (Farm Yard Manure, vermicompost and press mud) and biofertilizers (*Azotobacter*, phosphate solubilizing bacteria and *Azospirillum*) on growth and quality factors of strawberry. The experiment was tested in Complete Randomized Design (CRD) with three replications and consisted of ten treatments namely T1 (FYM + Azotobacter), T2 (FYM + PSB), T3 (FYM + Azospirillum), T4 (Vermicompost + Azotobacter), T5 (Vermicompost + PSB), T6 (Vermicompost + Azospirillum), T7 (Pressmud + Azotobacter), T8 (Pressmud + PSB), T9 (Pressmud + Azospirillum) and T10 (Control). Each treatment combination has exposed significant effects on most of the parameters, but the combination of vermicompost and PSB showed highest plant height (23.59 cm), leaves plant-1 (12.67), primary branches plant-1 (10.50), secondary branches plant-1 (27.35), first flowering (61.06 days),

flowers plant-1 (15.33), first fruit setting (72.80 days) and fruits plant-1 (8.33). Similarly, the treatments combination of vermicompost and PSB significantly synthetic the Total Soluble Solids (TSS) (10.75° Brix), titrable acidity (0.82), vitamin C (57.24 mg/100gm fruit), total sugars (5.95 %) and juice content (79.50 %).

Four combinations of two solid organic fertilizers (Monterra Malt and chicken manure) were applied before planting strawberry and two liquid organic fertilizers (broad bean and Pioner Hi-Fruit/K-Max) specified through drip irrigation (fertigation) and was compared with inorganic fertilization regarding growth, yield, nutrient concentration, and fruit quality of strawberries. Broad bean fertigation combined with Monterra Malt resulted in a alike fruit yield as inorganic fertilizer and a higher yield than Monterra Malt combined with Pioner; however, total soluble solids, firmness, and titratable acid were improved with Pioner fertigation, although these parameters were more affected by harvest time than the applied fertilizers. The concentrations of most nutrients in fruits and leaves were greater in inorganically fertigated plants. The reductions in fruit yield in three of four treatments and fruit weight in all organic treatments may be due to a combination of the following conditions in the root zone: (1) high pH and high NH4 +/NO3 – ratio; (2) high EC and/or high NaCl concentration; (3) cation disparity; and (4) nutrient deficiency (Pokhrel *et al.*, 2015).

Rakesh and Adarsh (2010) stated that soil and 45% cowdung + vermicompost increase various growth and yield parameters of tomato like mean stem diameter, mean plant height, yield/plant, marketable yield/plant, mean leaf number, total plant biomass were noted for each treatment. The efficacy of Seaweed leachate of different concentrations attained from green seaweed *Ulva lactuca* was assessed on the growth, pigments, total chlorophyll, total protein, total carbohydrate and total lipid and the yield of a flowering plant *Tageteserecta*. The mutual effect of 1.0% SLF of *U. lactuca* with different

proportions of recommended rate of chemical fertilizers was also made on the test plant. Among the concentrations, plants that received 1.0% SLF and 50% recommended rate of chemical fertilizers presented a maximum growth characteristic, total number of flower and fresh weight of flowers (Sridharand Rengasamy, 2010).

Melek Ekinci *et al*. (2014) carried out an experiment to decide the effects of nanotechnology liquid fertilizer on the plant growth and yield of cucumber (*Cucumis sativus* L.). The doses of 2.0, 3.0 and 4.0 L ha-1 of Nanonat and Ferbanat were recycled as fertilizer source. The plant leaves were sprayed with Nanonat and Ferbanat suspension until becoming wet at ten day intermissions for three times during plant growth. The results showed that the fertilizer treatments significantly improved the yield related to control. The highest yield (149.17 t ha-1) occurred in Ferbanat 4.0 L ha-1 application. As a result, 7 this study proposed that the foliar applications of liquid fertilizer could improve the plant growth and yield of cucumbers.

CHAPTER III

MATERIALS AND METHODS

This chapter demonstrates information regarding methodology that was exploited in accomplishment of the experiment. It encompasses a brief outline of the location of the experiment, climate conditions and the materials used for the experiment. It also flourishes the treatments of the experiment, data collection and data analysis procedures

3.1 Study area

The research was conducted at the Horticultural farm of Sher-e-Bangla Agricultural University. The study was carried out during the period from February2017 to July 2017 at Horticulture Farm, Sher-e-Bangla Agricultural University, Dhaka, Bangladesh. It lies within the $23^0$74' N latitude and $90^0$35' E longitudes with an elevation of 8.2m from sea level (FAO) in the Agro-Ecological Zone of Madhupur Tract (AEZ No. 28).

3.2 Climatic condition

The Experimental site was located in the subtropical monsoon climatic zone, characterized by a heavy rainfall during the months from April to September (Kharif season) and a scantly rainfall during the rest of the year (Rabi season). Plenty of sunshine and moderately low temperatures prevail during October to March (Rabi season), which is suitable for bitter gourd (the test plant) growing in Bangladesh. Temperatures above 25^0c accompanied by high humidity and strong wind, result in reduced yield. Night temperature above 20ºC accompanied by high humidity and low sunshine lead to excessive vegetative growth and poor fruits production. High humidity leads to a greater incidence of pests and diseases and fruit rotting. Summer season is therefore preferred for bitter gourd production.

3.3 Geology and Soil

The inherent soil character closely related to "The Modhupur Tract", AEZ-28. Upper layer of soil was silt clay in texture, olive-gray with common fine to medium distinct dark yellowish brown mottles. The area was well furnished with irrigation and drainage network and above level. The selected plot was medium high land.

3.4 Planting materials

Seeds of Bitter gourd variety (Ranipukur) were collected from the Advanced Seed Research and Biotech Centre (ASRBC), ACI Limited.

3.5 Treatments of the experiment

The single factor experiment was conducted to observe the effects of organic leachate on growth and yield of bitter gourd.

Treatments were as follow:

Treatment	Basal Application	Top Dressing at 15 days interval in 3 times
T_1	BARI dose	----(control)
T_2	BARI dose	Cowdung leachates
T_3	BARI dose	Vermicompost leachates

3.6 Leachates preparation

Vermicompost, Cowdung at the rate of 250g and 150g each respectively were placed into a jar with 10 litter tap water. The mixture was stired continuously for thorough mixing. Then the mixture was kept in room temperature for about 48 hours to filtrate the liquid extract. The

leachate extracts were then separated from the solution and applied in the soil as side dressing.

3.7 Experimental design

The experiment was laid out in a Randomized Complete Block Design (RCBD) with three replications. The experiment was divided into three blocks and consisted of 9 plots. Each unit plot in from of raised bed was 6 m^2 (2m x 3m) in size. Altogether there were 9 unit plots in experiment and required 110 m^2 land. Row to row and plant to plant distance were 1 m and 25 cm respectively. The treatments were randomly assigned to each of the block. Each unit plot had 2 rows and each with 3 plants. So there were 6 plants per unit plot.

3.8 Land preparation

Soil was well pulverized by power tiller and was exposed to sun about one week. Then several ploughing followed by cross ploughing, harrowing, spading and laddering done for uniform soil making. Weeds and stubbles were completely removed and soil was treated by little amount of lime (5kg/plot) to keep the soil free from pathogen. The plots were divided into several uniform blocks according to experimental design (mentioned earlier).

3.9 Manures and fertilizer application

Manures and well decomposed organic matter were used @ 15 ton per hectare before terminating land preparation. The chemical fertilizers like Urea, TSP, MOP were mixed with soil as the source of nitrogen, phosphorus and potassium at the rate of 100, 200 kg and 90 kg per hectare respectively as basal application during final land preparation (BARI, 2011). Organic leachate *viz*., cow dung and vermicompost were applied at 15 day‟ s interval three times in same plot.

3.10 Sowing of seeds and transplanting of seedling

Seeds were sown in polybags having compost mixed soil on 5 February 2017 for germination and seedling raising. Two seeds were sown in each polybag. The polybags were kept in shady place. They were watered regularly during the seedling raising period. When the seedlings (11 days old) attained 4 leaves and hard enough, they were transplanted in the main field on 10 April 2017.

3.11 Intercultural operations

3.11.1 Gap filling

Dead, injured and weak seedlings were replaced by new vigor seedling from the same stock of the experiment.

3.11.2 Weeding

Weeding was done after transplanting to prevent competition between the plants and weeds. Weeding was done with a hoe three times during the study period. First weeding was carried out four weeks after transplanting and the second and third weeding were carried six and eight weeks respectively after transplanting.

3.11.3 Irrigation

Surface irrigation was commonly practiced during the experimental period. Due to crops specific demands for high soil water content achieved with leaf wetting, irrigation has been successfully applied throughout the growing season.

3.11.4 Vine management

Stormy weather may cause the tendering vine of the plants fell down from the supports (Trellis). For proper growth and development of the plants the vines were managed upward with the help of iron rope by hand.

3.11.5 Pest control

For protection of protect from the attack of insects-pests specially fruit flies and fruit borer by spraying of pesticides. Since there was no incidence of disease no fungicide was applied in the crop field during the experimental period.

3.11.6 Trellis

Six bamboo poles were set slantingly keeping 5 feet high from the ground level in every plot. The poles were connected to one another tightly by iron rope in such a way that they make opposite "V" shaped. A net from rope were placed on iron rope. Thus a trellis for each plot was made for creeping the vines of crop.

3.12 Harvesting

Total 8 times harvesting was done. Harvesting was done at seven days interval from every plant of every plot for collecting data.

3.13 Collection of experimental data

Data were recorded on the following parameters.

Growth related parameter

- Plant height (cm)
- No. of leaves/plant
- No of branches /plant

Duration related parameter

- Days to first flowering from transplanting
- Days to first fruit setting from transplanting

Yield related parameter

- No.of flower per plant
- No of fruit per plant
- Single fruit weight (g)
- Fruit length (m)
- Fruit diameter (mm)
- Yield / plant (kg)
- Yield /hectare (t)

3.13.1 Plant height (m)

Plant height was measured with a ruler. It was done by measuring the plant from the base at the ground level to the terminal growth point. The height was recorded for the sampled plants and the mean was determined by dividing the total heights with total number of plants at final harvest.

3.13.2 Number of leaves per plant

This was determined by single counting the mature leaves per plants and average was taken at mature stage.

3.13.3 Days to 1st flowering

Each plot was daily observed to record the date of first flowering. The period from the transplanting date to the date of first flowering was recorded and expressed in term of number of days. The average values per line were calculated on plot basis.

3.13.4 Number of flowers

Number of flower cluster per plant was determined . This data was taken at first flowering time.

3.13.5 Days to 1st fruiting

Days to first fruiting were recorded from transplanting date to the date of first fruiting of every entry.

3.13.6 Number of fruits per plant

The number of fruits in every plant of bitter gourd was counted at every harvest and thus the total number of fruits per plant was recorded and average number of fruits was calculated.

3.13.7 Number of branch

Number of branches per plant was counted at first flower stage and average was calculated.

3.13.8 Weight per fruit (g)

Fruit collect form three randomly tagged plants of each treatment were weighted with the help of an electric precision balance in gram. Total fruit weight of each plot was obtained by addition of individual fruit weight and mean fruit weight was acquired from division of total fruit weight by total number of fruits which was shown in plate no.1.

3.13.9 Length and diameter of fruit (mm)

Fruit length and diameter were measured using Digital Caliper-515 (DC-515) in millimeter (mm). Mean value was determined for each treatment (plate no.1).

3.13.10 Yield/plant (kg)

Fruit yield/ plant were calculated from weight of total fruits divided by number of total plants.

3.13.11 Yield/ha (ton)

Yield/ ha was computed and expressed in ton per hectare.

3.13.12 Statistical analysis

The collected data as per specific parameters were statistically analyzed to find out the significant variation between different treatments. The mean values were evaluated to measure the analysis of variance by the "F" (Variation ratio) test following MSTAT-C computer packaging program. How these test results have statistically significant was estimated by the least significant difference (LSD) test at 5% level of significance (Gomez and Gomez, 1984).

a

b

c

d

Plate 1. Pictorial presentation: a. Whole plant of bitter gourd b. Fruit length measuring by meter scale c. Fruit weight measurement by using Electronic Precision Balance in gram d. Fruit length and diameter were measured using Digital Caliper-515 (DC-515)

CHAPTER IV

RESULTS AND DISCUSSION

The experiment was performed to evaluate growth and yield of bitter gourd and its yield performance against different organic leachate. Findings of the research work have been presented and discussed in this chapter. Illustration of this chapter has been focused by tables and figures to enhance their parallel and dissimilar character through discussion, comprehension and perceiving. A summary of the analysis of variances in regard to all parameters have been shown in appendix. Results have been presented, discussed and possible interpretations are given under the following headings.

4.1 Plant height (m)

It is considered that plant height is the most influential parameter among others, which is positively correlated with the yield of bitter gourd. Plant height was recorded before final harvest. Organic leachate influence plant height of bitter gourd (Appendix I) and height of bitter gourd exposed statistically significant inequality among recommended basal dose of BARI, cowdung leatches, vermicompost leatches (Figure 1). The mean plant height ranged from 2.61m to 2.85m. Tallest plant (2.85m) was observed in T_3 treatment whereas least height (2.61m) was in T_2 treatment at before final harvest of different bitter gourd. Study referred that vermicompost increase plant height and judgment represents similar findings to Federico *et al.* (2007). Where found that vermicompost leachate induced the largest increase in tomato plant heights and stem diameters in the 1:4 vermicompost:soil treatment. Microbes like fungi, bacteria, yeasts, actinomycetes, algae etc are capable of producing auxins, gibberellins etc in appreciable quantity during vermicomposting (Brown, 1995; Arancon *et al.*, 2004), which affects plant growth appreciably (Tomati *et al*., 1987; Arancon *et al*., 2006). Rakesh *et al*. (2010) also reported that mean plant height (cm) of bitter gourd in treatments VC15 (Soil+15% VC), VC30

(Soil+30% VC), VC45 (Soil+45% VC) were 63cm, 63.4cm and 63.5 cm respectively, which were greater than mean plant height of 38cm reported in soil (control). Vermicompost was not so stimulatory or was inhibitory in the mineral soil which contained higher N, P and K than the peat medium. Changes in the physical properties of the medium may have also contributed to increase plant growth.

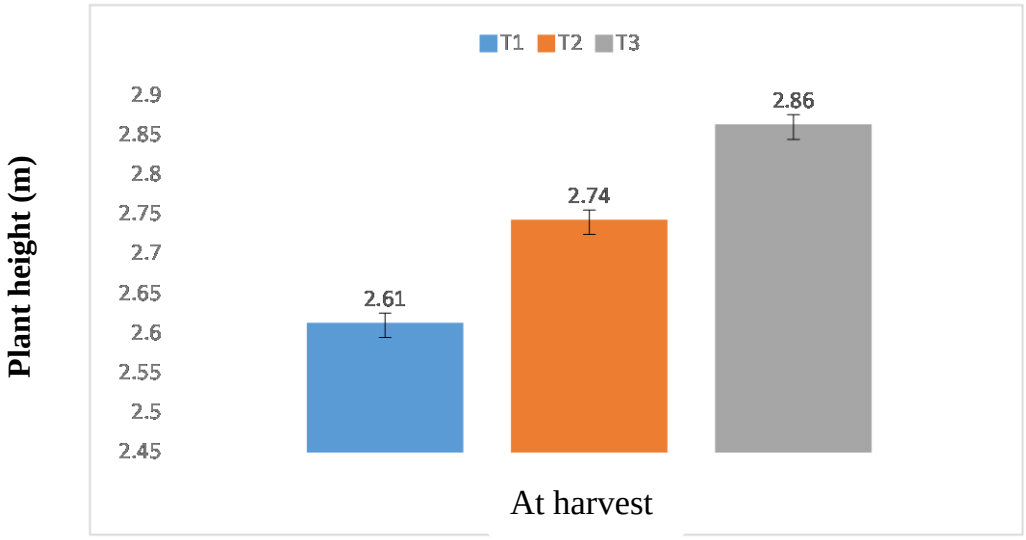

Fig.1. Performance of organic leachates on plant height at harvest (vertical bar indicates LSD value)

T_1: Control(BARI fertilizer dose as basal) T_2: BARI fertilizer dose (basal) + cowdung leachate as top dressing, T_3: BARI fertilizer dose (basal) + vermicompost leachate as topdressing

4.2 Number of leaves per plant

Leaves are important vegetative organ, as it assists plant in photosynthesis, transpiration and respiration process**.** Different nutrients have appreciated effect on the number of leaves per plant at different DAT. Higher leaf number

indicates wholesome growth and development. Total number of leaves per plant showed significant influence on yield of bitter gourd (Appendix II). The mean highest leaf per plant (17.00/plant) was recorded from T_3 treatment whereas T_2 treatment showed the lowest leaves (11.00/plant) (Figure 2) at 45 days after transplantation. Due to available nutrient in vermicompost leachate, plants grown with this treatment produce higher number of leaves. Result was supported by Yourtchi *et al.*, (2013) and Bongkyoon *et al.*, (2004) who mentioned that application of vermicompost performed the best response on leaf number of potato plant

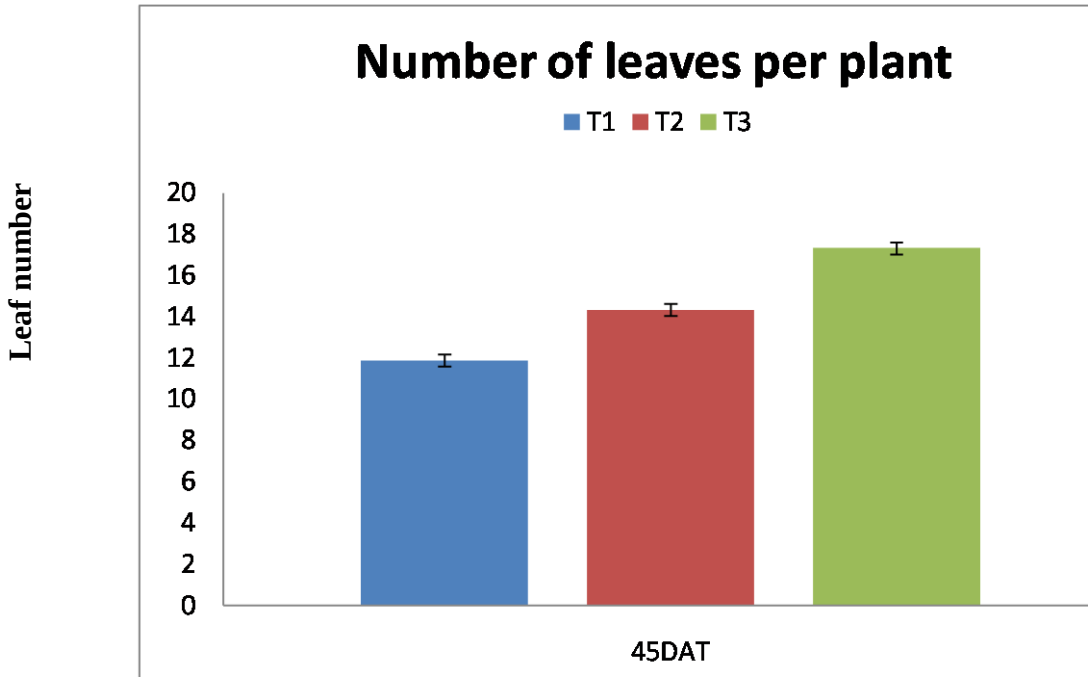

Fig.2. Performance of organic leachates on leaf number at 45 DAT (Vertical bar indicates LSD value)

T_1: Control (BARI fertilizer dose as basal) T_2: BARI fertilizer dose (basal) + cowdung leachate as top dressing, T_3: BARI fertilizer dose (basal) + vermicompost leachate as topdressing

4.3 Days to 1st flowering

Significant dissimilarity was found in days to first flowering due to different treatments (Appendix IV) Earliest flowering (13.88 days) was observed in T_3 treatment while late flowering (15.88 days) was in T_1 Treatment (Table 1). The result showed that T_3 is early flowering Treatment and T_2 is late flowering Treatment. Vermicompost produced from cattle and pigs manure as well as food wastes increased the rate of germination, growth and flowering of a range of ornamental and vegetable seedlings compared with vermicompost from other sources (Atiyeh *et al*., 2000). In an experiment involving vermicompost derived from water hyacinth (*Eichhornia crassipes* L.) on the growth and flowering of *Crossandraund ulaefolia* showed best performance. The amount of vermicompost had a significant effect on not only growth and flowering of the Marigold plants, but also on the plant shoot, Plant growth regulator cause height and diameter of the flowers (Pritam *et al*., 2010). Such effects of vermicompost on flowering and fruiting of strawberry might be attributed to the fact that higher doses of vermicompost have resulted in to better growth of plants and consequently they took lesser days to flower and produced higher fruit yield than those receiving inorganic fertilizers only (Bulluck, 1995; Atiyeh *et al*., 2000, 2001; Arancon *et al*., 2004, 2006).

4.4 Number of flowers

Number of flower cluster per plant was significantly varied in bitter gourd with different treatment levels (Appendix IV). The number of flower was the highest flower per plant (37.11) found in T_3 treatment which was statistically similar to T_2 . The lowest flower per plant (30.22) found in T_1 treatment (Table 1). Present study notifies that application of vermicompost leachate to bitter gourd increases number of flower per plant which is alike to Nileemas and Sreenivasa (2011). Vermicompost pretreated soil enhance flower number in *Pisum sp.* and *Cicer sp*. (Sinha *et al*., 2010) also in *Hibiscus esculentus* (Vanmathi and Selvakumari, 2012).

Table 1. Performance of organic leachates on bitter gourd related to Days to 1st flowering and number of flower.

Treatment	Days of 1st flowering	No. of flower
T_1	15.88 c	30.22 c
T_2	15.00 b	33.44 b
T_3	13.88 a	37.11 a
$LSD_{0.05}$	0.79	0.81
CV%	4.37	1.97

[X] In a column, means having similar letter (s) are statistically identical and those having dissimilar letter (s) differ significantly as per 0.05 level of probability.

[Y] In T_1: Control (BARI fertilizer dose as basal) T_2: BARI fertilizer dose (basal) + cowdung leachate as top dressing, T_3: BARI fertilizer dose (basal) + vermicompost leachate as topdressing

T_1

T_2

T_3

Plate 2. Pictorial presentation T_1: BARI fertilizer dose (basal) + cowdung leachate as top dressing, T_2: BARI fertilizer dose as basal T_3: BARI fertilizer dose (basal) + vermicompost leachate as topdressing

4.5 Days to 1st fruiting

Organic leachate influence days to 1st fruit setting of bitter gourd (Appendix V) and fruit setting of bitter gourd exposed statistically significant inequality among recommended basal dose of BARI, cowdung leatches, vermicompost leatches . Data reveals that early fruit setting (16.11 days) was in T_3 treatment where vermicompost was applied . Delay fruiting (18.22 days) was observed in T_1 treatment (Table 2). The results indicate that T_3 was early fruiting Treatment and T_2 was late one.

4.6 Number of fruit

Different treatments remarkably influenced production of fruit per plant (Appendix V). . Maximum number of fruits per plant was recorded in T_1 (19) and minimum was recorded in T_2 (14.33).(Table 2). This finding is corresponding with Patil *et al*. (2004. Vermicompost has larger populations of bacteria, fungi and actinomycetes compared with conventional composts also outstanding physico-chemical and biological properties (Nair *et al*., 1997) can increase number of fruit

Table 2. Performance of organic leachateses on bitter gourd related to Days to 1st fruiting and number of fluit

Treatment	Days to 1st fruiting	Number of fruit per plant
T_1	18.22 a	14.38 b
T_2	17.22 b	13.88 b
T_3	16.00 c	19.00 a
$LSD_{0.05}$	0.55	0.89
CV%	2.63	4.53

[X] In a column, means having similar letter (s) are statistically identical and those having dissimilar letter (s) differ significantly as per 0.05 level of probability.

[Y] In T_1: Control (BARI fertilizer dose as basal) T_2: BARI fertilizer dose (basal) + cowdung leachate as top dressing, T_3: BARI fertilizer dose (basal) + vermicompost leachate as topdressing

4.7 Number of branch

Number of branches per plant was significantly influenced by the application of recommended basal dose of BARI, cowdung leatches, vermicompost leatches (Table 3). The maximum number of branches per plant was obtained from T_3 treatment (12.00) and the minimum number of branches was inT_1 . Highly significant variation was found in respect of total number of branches per plant at first flowering due to different organic leatches practice (Appendix VI).

4.8 Single fruit weight

Bitter gourd fruit weight was varied significantly by the application of different organic leachate (Appendix VI). Maximum fruit weight (94.72 g) was found in T_3 treatment and whereas lowest (76.37 g) in T_1treatment (Table 3). . Deore *et al*. (2010) also found higher fruit yield in chilli (360.1 g/plant) in 3 % vermicompost treated plants, which might be due to increase in values of fresh weight of the fruits per plant. Similar result was also reported by Kondapa *et al*. (2009) Singh *et al*. (2010) and Mamta *et al*. (2012) (brinjal). Fruit weight of okra was also reported to increase due to the amplification of nutrient content through the application of vermicompost (Attarde *et al*., 2012). Besides vermicompost reduces C: N ratio (Nagavallemma *et al*., 2004) which might be responsible for the maximum fruit weight.

Table 3. Performance of organic leachates on bitter gourd related to Number of branch and Single fruit weight

Treatment	No. of branch	Single fruit weight(g)
T_1	9.00 c	76.37c
T_2	11.22 b	88.87b
T_3	12.00 a	94.72 a
$LSD_{0.05}$	0.88	3.39
CV%	6.47	3.22

[Y] In a column, means having similar letter (s) are statistically identical and those having dissimilar letter (s) differ significantly as per 0.05 level of probability.

[Y] In T_1: Control (BARI fertilizer dose as basal) T_2: BARI fertilizer dose (basal) + cowdung leachate as top dressing, T_3: BARI fertilizer dose (basal) + vermicompost leachate as topdressing

4.9 Fruit length (cm)

Organic leatches had the strong positive effect on the fruit length of bitter gourd. Among the three treatment maximum fruit length was recorded from T_3 (16.04 cm) followed by T_2 (14.36 cm) and minimum fruit length (13.03 mm) was found in Treatment T_1 (Table 4) (Plate no.2). Same result also found by Singh and Upadhayaya (1967) in tomato. There was a highly significant effect on fruit length due to the different organic leatches management practices (Appendix VII). The effect of fertilizer management practices in the present investigation was in conformity with the result of Naik and Srinivash (1992).

4.10 Diameter of fruit (mm)

Variation was found in case of diameter of fruit of bitter gourd (Appendix VII). The diameter of fruit was higher up to vermicompost leatches was (44.36 mm) and minimum was cowdung leatches found (42.17 mm)(Table 4) .T_3 treatment was best compared to T1 and T2 treatment for increasing fruit length as well as fruit diameter (Plate no.2) .

Table 4. Performance of organic leachates on bitter gourd related to Fruit length and Fruit diameter

Treatment	Fruit length(cm)	Fruit diameter(mm)
T_1	13.033 c	42.178 c
T_2	14.36 b	43.63 b
T_3	16.04 a	44.36 a
$LSD_{0.05}$	0.44	0.38
CV%	2.51	0.72

[X] In a column, means having similar letter (s) are statistically identical and those having dissimilar letter (s) differ significantly as per 0.05 level of probability.

[Y] In T_1: Control (BARI fertilizer dose as basal) T_2: BARI fertilizer dose (basal) + cowdung leachate as top dressing, T_3: BARI fertilizer dose (basal) + vermicompost leachate as topdressing

4.11 Yield (kg/ plant)

It was observed from the results that bitter gourd statistically differed by means of the total fruit weight per plant due to different treatments (Appendix VIII). Maximum yield per plant (1.68 kg) of bitter gourd was observed in T_3 treatment and it was analogous to T1 treatment (1.33 kg) whereas lowest yield was found in T_2 treatment (1.05kg) (Table 5). This findings is similar to Deore (2010) who reported that higher fruit yield in chilli was (360.14 g/plant) in 3 % organic liquid treated plants, which might be due to increase in values of fresh weights of the fruits per plant. Similar results were obtained by Kondapa *et al*. (2009) in chilli plants treated with organic fertilizers. 3.0 L ha^{-1} doses of Nanonat and Ferbanat applications have improved the yield of tomatoes (Ekinci *et al*., 2012) and in potatoes with 35–40% and in cabbages with 38–42% (Ferbanat, 2013). Such effects of vermicompost on flowering and fruiting of strawberry might be attributed to the fact that higher doses of vermicompost have resulted in to better growth of plants and consequently they took lesser days to flower and produced higher fruit yield than those receiving inorganic fertilizers only (Brown, 1995; Atiyeh *et al*., 2000, 2001; Arancon *et al*., 2006)

4.12 Yield (t/ha)

Significant variation was recorded for yield per hector among bitter gourd with respect to different treatments (Appendix VIII). The highest yield (9.89 t/ha) was found from T_3 treatment followed by T1 treatment (8.29 t/ha) while the lowest result was found from T_1 treatment (6.38 t/ha) (Table 5). Though organic fertilizers released nutrients more slowly than mineral fertilizers, resulting in decreased S and P concentrations in the leaves, which limit growth and yield, leachate treatment easily supplies their nutrient composition to the plants. So these treatments attributed to better vegetative growth, more number of fruits cluster per plant, highest average fruit weight, higher fruit set percentage and taller plants over.

Table 5. Performance of organic leachates on bitter gourd related to fruit yield (kg/plant) and yield (ton/ha.)

Treatment	Yield(kg/plant)	Yield(t/ha)
T_1	1.05 c	6.38c
T_2	1.33 b	8.98b
T_3	1.68 a	9.89a
$LSD_{0.05}$	0.12	0.83
CV%	7.11	8.38

[Z] In a column, means having similar letter (s) are statistically identical and those having dissimilar letter (s) differ significantly as per 0.05 level of probability.

[Y] In T_1: Control (BARI fertilizer dose as basal) T_2: BARI fertilizer dose (basal) + cowdung leachate as top dressing, T_3: BARI fertilizer dose (basal) + vermicompost leachate as topdressing

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CHAPTER V

SUMMARY AND CONCLUSION

Summary

Bitter gourd is mostly grown mainly in summer. It is a cucarbitacious crops which is one of the important vegetable in Bangladesh. For higher yield of bitter gourd, nutrient rich and fertile soil is necessary, but defecient of nutrient due to repeated cultivation, people use different type of chemical and organic fertilizer. Application of organic leatches is the best option for growth and yield attributes and environmental perspective.

In order to evaluate the performance of liquid fertilizer on Bitter gourd, an experiment was executed during the period of February, 2017 to July, 2017 was outlined in a Randomized Complete Block Design (RCBD) with three replications. Collected data were statistically analyzed to evaluate the performance of different treatments. The findings of the experiment are summarized in this chapter. The mean plant height ranged from 2.61m to 2.85m. Tallest plant (2.85m) was observed in T_3 treatment whereas least height (2.61m) was in T_1 treatment at before final harvest of bitter gourd. The mean highest leaf per plant (17.33) was recorded from T_3 treatment whereas T_1 treatment showed the lowest leaves per plant (11.88) at 45 days after transplantation. Horticulture farm, Sher-e-Bangla Agricultural University. Three treatments were used in this experiment and earliest flowering (13.88 days) was observed in T_3 treatment while late flowering (15.88 days) was in T_1 Treatment. The number of flower was the highest per plant (37.11) in T_3 treatment The lowest (30.22 flower/plant) was in T_1 treatment. Data reveals that early fruit setting (16.00days) was in T_3 treatment which was statistically similar to T_2 treatment where vermicompost was applied. Delay fruiting (18.00 days) was observed in T_1 treatment.

Treatment T_3 produced maximum number (19.00 fruit /plant) of fruits. The maximum number of branches per plant was obtained from T_3 treatment (12.88) and the minimum number of branches was observed in control T_2 was found (9.00). Among the three treatments maximum fruit length was recorded from T_3 (16.04 cm) followed by T_2 (14.36 cm) and minimum fruit length (13.03 cm) was found in treatment T_1. The diameter of fruit was higher up to vermicompost leatches was 44.36 mm and minimum was cowdung leatches found 42.17 mm .T_3 treatment was best compared to T_1 and T_2 treatment for increasing fruit length as well as fruit diameter. Maximum yield per plant (1.68 kg) of bitter gourd was observed in T_3 treatment and it was analogous to T_2 treatment (1.33 kg) whereas lowest yield was found in T_1 treatment (1.05kg). Significant variation was recorded for yield per hector among bitter gourd with respect to different treatments. The highest yield (9.89 t/ha) was found from T_3 treatment followed by T_2 treatment (8.29 t/ha) while the lowest result was found from T_1treatment (6.38 t/ha).

Conclusion

Regard as the above summary, it can be concluded that vermicompost leachate performs as an excellent result among other treatments in terms for growth, yield attributes of bitter gourd. As the yield of bitter gourd was higher in vermicompost application than cowdung leatches and chemical fertilizer hence T_3 treatment can be used in replace to T_1 and T_2 treatment.

Suggestion

Results are presented on the basis of one-year experiment; further trials are needed to substantiate the results.

APPENDICES

Appendix I. Analysis of variance on plant height of Black cherry tomato at different days after transplanting

Source of Variation	Degrees of freedom (df)	Mean square of plant Height
Factor A	2	0.132*
Error	16	0.00107

*: Significant at 0.05 level of probability

Appendix II. Analysis of variance on leaf number of Bitter gourd after 45 days

Source of Variation	Degrees of freedom (df)	Mean square of leaf number
Factor A	2	66.925*
Error	16	0.3843

*: Significant at 0.05 level of probability

Appendix III. Analysis of variance days to 1st flowering and number of flower of bitter gourd at different treatments

Source of Variation	Degrees of freedom (df)	Mean square days to 1st flowering	Mean square number of flower
Factor A	2	9.037*	106.926*
Error	16	0.4259	0.440

*: Significant at 0.05 level of probability

Appendix IV. Analysis of variance on Days to 1st fruiting and number of fruit at different treatments

Source of Variation	Degrees of freedom (df)	Mean square Days to 1st fruiting	Mean square number of fruit
Factor A	2	10.037*	55.259*
Error	16	0.203	0.537

*: Significant at 0.05 level of probability

Appendix V. Analysis of variance on number of branch and fruit weight of Bitter gourd at different treatments

Source of Variation	Degrees of freedom (df)	Mean square No. of branch	Mean square Fruit wt.
Factor A	2	25.00*	790.53*
Error	16	0.527	7.80

*: Significant at 0.05 level of probability

Appendix VI. Analysis of variance on Fruit length and fruit diameter of bitter gourd at different treatments

Source of Variation	Degrees of freedom (df)	Mean square Fruit Length	Mean square Fruit diameter(mm)
Factor A	2	7.80*	11.181*
Error	16	0.132	0.643

*: Significant at 0.05 level of probability

Appendix VII. Analysis of variance on Yield/plant and Yield/ha of bitter gourd at different treatments

Source of Variation	Degrees of freedom (df)	Mean square Yield/plant	Mean square Yield/ha
Factor A	2	0.886*	27.829*
Error	16	0.009	0.470

*: Significant at 0.05 level of probability