INTERNATIONAL JOURNAL OF PLANT, ANIMAL AND ENVIRONMENTAL SCIENCES
IJPAES
Volume-9, Issue-2 April-June-2019 Coden:IJPAJX-CAS-USA, Copyrights@2018 ISSN-2231-4490
Received: 2nd Mar-2019 Revised: 15th May-2019 Accepted: 28th May-2019
DOI: 10.21276/Ijpaes http://dx.doi.org/10.21276/ijpaes Research Article

EFFECT OF COMPOST AND VERMICOMPOST PREPARED FROM DIFFERENT BIODEGRADABLE WASTES ON THE GROWTH OF KING CHILLI *CAPSICUM CHINENSE*

Mithra Dey[1], Mohilal N[2], Sunita Mongjam[1*]

Department of Ecology and Environmental Sciences, Assam University, Silchar, Assam, India
Professor, Department of Life Sciences, Manipur University, Imphal, Manipur, India

Abstract: Vermicompost is becoming one of the best organic fertilizers which have an important contribution to agriculture. In fact, it contains more plant nutrients than that of organic compost. The research experiment is focuses on the nutrients present in vermicompost and its important role on the growth and yield of King Chilli, Capsicum chinense commonly known as U-Morok in Manipur. Study was carried out at garden of Life Sciences department, Manipur University, Canchipur, Imphal West, Manipur. Phumdi biomass were collected from Loktak lake, Moirang and Municipal Solid Waste (organic) was collected from Lamdeng Khunou, Lamsang, Imphal West. Vermicomposting of these wastes were done by mixing with cow dung slurry in the ratio 3:1 and precomposted for three weeks. An experiment was conducted for 60 days by using three species of earthworms, Eisenia fetida, Eudrilus eugeniae and Perionyx excavatus. Vermicompost obtained from the above observation were further utilised in plantation of Capsicum chinense. The seedlings of Capsicum chinense were planted in five sets of pots having three replicates each. Two sets of pots were filled with compost and vermicompost of Phumdi, the other two sets are filled with compost and vermicompost of Municipal Solid Waste while the fifth set was filled with soil and kept for control. The experiment was set up and observed for 150 days.The plants were watered regularly for every alternate day. Various growth and yield parameters like mean stem diameter, mean plant height, marketable yield fruit per plant, non-marketable fruit per plant, total plant biomass were recorded for each treatment. The presence of heavy metals (Fe, Zn, Mn and Cu) and nutrients (N, P, K) in the compost, vermicompost and soil were analysed. The plant biomass (dry form) grown in compost and vermicompost of phumdi and Municipal Solid Waste and soil were determined for the presence of nutrients and heavy metals. The nutrients present in the vermicompost were found to be higher than that of compost and soil. Almost all the plant growth, yield and nutrient parameters increased significantly in vermicompost and compost when compared to that of soil or control.
Key words: Earthworms; Plant nutrients; Organic Compost; Heavy metals; Umorok; Capsicum Chinense; Phumdi; Municipal Solid Waste

*Corresponding autor: Sunita Mongjam, Department of Ecology and Environmental Sciences, Assam University, Silchar, Assam, India, E-mail: sunita.mongjam@gmail.com

INTRODUCTION

Capsicum chinense is the hottest chilli in the world. It can be grown under diverse soil and climatic conditions. It is widely cultivated in Manipur [1].It has medicinal value and said to be used in the treatment of atherosclerosis, shock, haemorrage, heart attack, etc. King chilli is loaded with vitamins like niacin, pyridoxine, riboflavin, and thiamine. It is also a good source of folic acid. Folic acid helps the body to produce healthy red blood cells and prevents anaemia.

The chemical that causes the spiciness in chilli is capsaicin, which is what creates hot and pungent. Potassium present in King chilli may reduce the risk of heart disease, copper present in it is an essential antioxidant trace element, important for strong bones and healthy neurons. It is rich in Beta carotein which later converts into Vitamin A. Capsicum annuum is rich in Vitamin A, C and E [2]. Vermicompost is a fine granular organic matter with high porosity, aeration and water holding capacity. Vermicompost have higher levels of organic matter organic carbon, total available NPK, micronutrients, microbial enzymes and plant growth regulators [3, 4]. There are reports that concentrations of exchangeable cations such as Ca, Mg, Na, K, available P and Mo in vermicompost are higher than those in the surrounding soil [5].Vermicompost, used as soil additives, or as a components of green house bedding plant container media, have improved seed germination, enhanced seedling growth and development, and increased productivity [6]. Experiments have been conducted on positive effects of vermicompost application on plant growth like Chilli [7], tomato [8], marigold [6], onion [9] and Strawberry [10]. Vermicompost affected positively the growth of Begonias and Coleus [11].Various greenhouse and field studies have examined the effects of a variety of vermicomposts on a wide range of crops including cereals and legumes, paddy, sugarcane and wheat, vegetables like tomato (Lycopersicum esculentum), brinjal (Solanum melongena) and okra (Abelmoschus esculentus) etc. Ornamental and flowering plants [6] and field crops [10]. Thus modern agriculture aims to develop a rich food at a reasonable rate, all The main objectives of the present study were to access the effects of vermicomposton the growth, yield and quality of King chilli plants planted in the experimented pots.

MATERIALS AND METHODS

The experiment was carried out in two phases, (i). vermicomposting of MSW and *Phumdi* were done in the month August-November 2016 and (ii). Pot plantation of king chilli was done during, 16th January – 15th, June 2017, at the Department of Life Sciences, Manipur University, ImphalWest, Manipur.

(a) **(b)**

Figure 1: (a)MSW at Lamdeng Khunou, Lamsang; (b) Phumdi at Loktak Lake, Moirang.

Preparation of vermicompost

The samples collected from different places of Municipality solid waste dumping and processing site, LamdengKhunou, Lamsang and Phumdi of the Loktak lake, Moirangwere brought at MU Campus, Canchipur. The waste samples were sorted by segregating and discarding the nonbiodegradable fraction and the biodegradable components were mixed with cow dung slurry in the ratio 3:1 and kept for precomposting for 21 days.On the 22nd day the precomposted substrates of both MSW and *Phumdi* were taken for vermicomposting and composting by adding five kilograms each to a total of eight sets of earthen pots (4 sets for MSW and 4 sets for *Phumdi*), each set comprising of three replicates. In three sets of pots, each of MSW and Phumdi, three species of adultearthworms with clitellum i.e. *Perionyx excavates*, *Eisenia fetida* and *Eudrilus eugeniae*; 50 in number, were introduced on the surface of substrate keeping aside the fourth set without any earthworm, for composting. All the pots were covered on the top by jute cloth. The temperature and moisture content were maintained by sprinkling adequate quantity of water at frequent intervals. The harvesting of vermicompost and compost was done on the 60th day. Harvested vermicompost was analysed for bothmacro and micro-elements contents [12].

Figure 2: Harvesting of vermicompost and earthworm biomass.

Preparation of soil and vermicompost mixtures

Soil from the hillock of MU Campus were mixed with different vermicompost in the concentrations of 1:1 were used in the experiment. Five treatments were prepared as follows:(1). C (Soil as control); (2). C1 (50%soil +50%compost of MSW); (3).C2 (50%soil + 50%compost of *Phumdi*); (4). V1(50% soil + 50% Vermicompost of MSW) and (5). V2 (50%soil +50%vermicompost of *Phumdi*).

Seed Germination

Seeds were purchased from the market of Imphal city and were used in the experiment. Five plastic trays of size 8cm x 4cm x 2cm were used for all the five treatments and the trays were filled with 5gm of the treatment mixture.Then ten seeds were sown in each try with spacing of 1cm and a depth of 2cm. Germination was carried in each of the five treatments for 30 days. Only normal seedlings were used in transplanting for further experiment.

Growth and yield parameters

The seedlings were transplanted to the respective experimental pots. Thus the five sets of pots with three replicates each were planted with one plant per pot. Pots were watered regularly and kept for observation for three months. Various growth and yield parameters like mean stem diameter, mean plant height, yield per plant, marketable yield per plant, total plant biomass were recorded. Stem diameter was recorded using vernier callipers. Plant height was recorded using scale. The fruits were weighed using a weighing balance.

Chemical analysis of plant biomass

Analysis of the presence of N, P, K, Fe,Cu, Zn, Mn on soil, compost of MSW, *Phumdi*, Vermicompost of MSW, *Phumdi* is shown in Table 1. Determination of N content was done by Micro – Kjheldal method [13], while P and K contents were determine by UV Calorimeter [14] and Flame photometer [15] respectively. Trace elements like Iron (Fe), Copper (Cu), Zinc (Zn) and Manganese (Mn) were anlysed by the method proposed by Chapman et al. [16].

Statistical analysis

The experimental data were expressed as ± S.E.

RESULT AND DISCUSSION

Analysis of nutrients

The result indicates that the nutrients present in vermicompost are higher than that of the respective compost and soil. Vermicompost of MSW and *Phumdi* has highest Nitrogen content 1.5 than that of compost 1.4 and soil 1.07. Phosphorus has the highest value of 0.074, 0.081 in compost and Vermicompost of *Phumdi* than that of compost and vermicompost of MSWi.e. 0.065 &0.069 and soil i. e.0.01. Potassium has the highest record of 0.9 in vermicompost of *phumdi* and MSW second highest by compost of Phumdi (0.8) and thirdly compost of MSW (0.7) and with least record in soil i.e.0.1. (Figure 1). Iron has the highest record of 0.20, 0.21 in vermicompost of MSW and *phumdi* with least record in soil i.e. 0.09. Zinc records highest in both compost and vermicompost of *Phumdi* having 0.08 and 0.09 than that of compost and vermicompost of MSW i.e.0.05 &0.07 and soil with least content of 0.02. Copper records highest in vermicompost of MSW (0.012) second highest in vermicompost of *Phumdi* (0.009), compost of MSW (0.009) and least in soil (0.005). Manganese content is highest in vermicompost of *Phumdi* (0.06) and compost of *Phumdi* (0.05), whereas it decreases to 0.04 in both compost and vermicompost of MSW and soil has least contents of Manganese to 0.02 (Table 1 and Figure 2).

Table 1: Shows nutrients present in C, C1, C2, V1 and V2 respectively.

Nutrients	C	C1	C2	V1	V2
Nitrogen(%)	1.07	1.4	1.4	1.5	1.5
Phosphorus(%)	0.1	0.65	0.74	0.69	0.81
Potassium(%)	0.1	0.7	0.8	0.9	0.9
Iron (%)	0.09	0.18	0.19	0.20	0.21
Zinc (%)	0.02	0.05	0.08	0.07	0.09
Copper (%)	0.005	0.009	0.008	0.012	0.009
Manganese(%)	0.02	0.04	0.05	0.04	0.06

C =Soil, C1 =Compost of MSW, C2 = Compost of *Phumdi*, V1 = Vermicompost of MSW, V2 = Vermicompost of *Phumdi*.

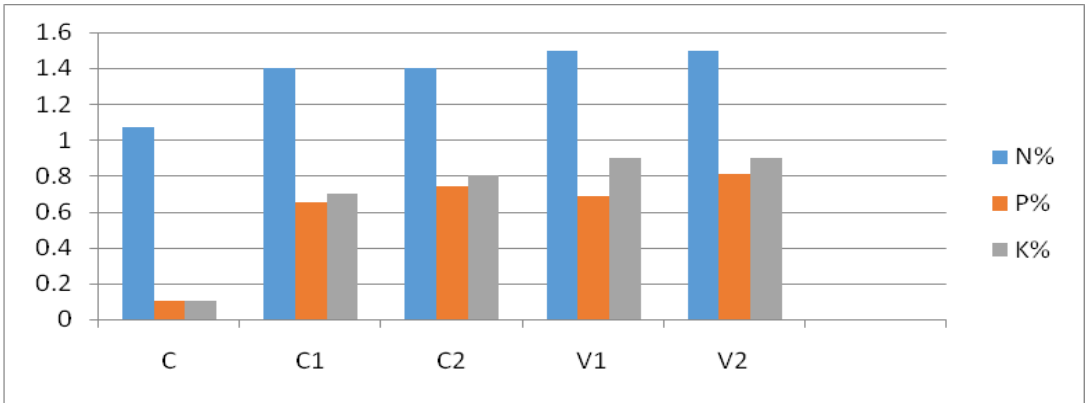

Figure 1:Macronutrients –NPK (%) concentration in soil (C), compost of MSW (C1), compost of *Phumdi* (C2), vermicompost of MSW (V1) and vermicompost of *Phumdi* (V2) prior to King Chili plantation.

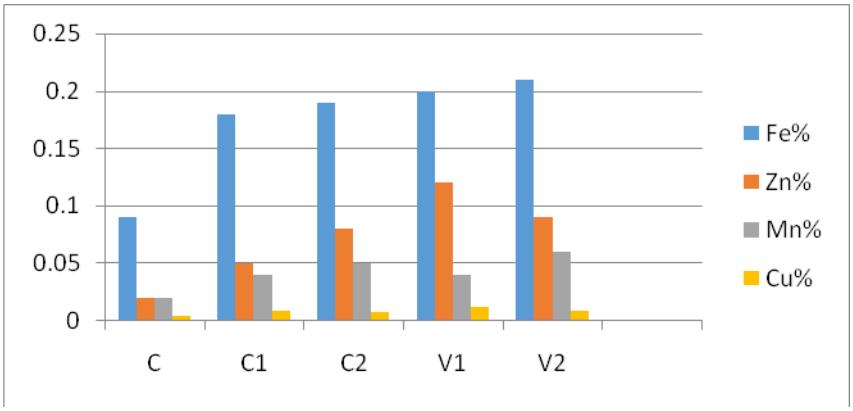

Figure 2:Heavy metal concentration – percentage of Fe, Zn, Mn and Cu present in soil (C), compost of MSW (C1), compost of *Phumdi* (C2), vermicompost of MSW (V1) and vermicompost of *Phumdi* (V2).

Table 2: Analysis of nutrients present in P, P1, P2, P3, P4 respectively, after harvesting (plant parts).

Nutrients in plants	P	P1	P2	P3	P4
Nitrogen (%)	1.01	1.2	1.21	1.4	1.4
Phosphorus(%)	0.01	0.053	0.071	0.051	0.072
Potassium (%)	0.09	0.5	0.4	0.5	0.5
Iron (%)	0.08	0.14	0.16	0.17	0.17
Zinc (%)	0.02	0.04	0.03	0.04	0.04
Copper (%)	0.002	0.007	0.006	0.007	0.07
Manganese(%)	0.01	0.02	0.02	0.02	0.03

where P=plant planted in soil medium, P1=Plant planted in compost of MSW,P2=Plant planted in compost of *Phumdi*, P3=Plant planted in vermicompost of MSW, P4=Plant planted in vermicompost of *Phumdi*

The result shows that Nitrogen content is more in the plant biomass P3 and P4 of King Chilli grown in vermicompost of MSW and *Phumdi* i.e.1.4, then reduces to 1.21 in compost of *Phumdi*, 1.2 in compost of MSW, and 1.01 in soil. Phosphorous concentration is more in P4 and P2 i.e. compost and vermicompost of *Phumdi* (0.072and 0.071) reduces to 0.053 in P1, compost of MS,0.051 inP3, vermicompost of MSW and 0.01 in P of soil. Potassium concentration records highest in P1,P3 and P4 having 0.5 value in each of the three and reduces to 0.4 in P2 and 0.09 in P (Table 2 and Figure 3).

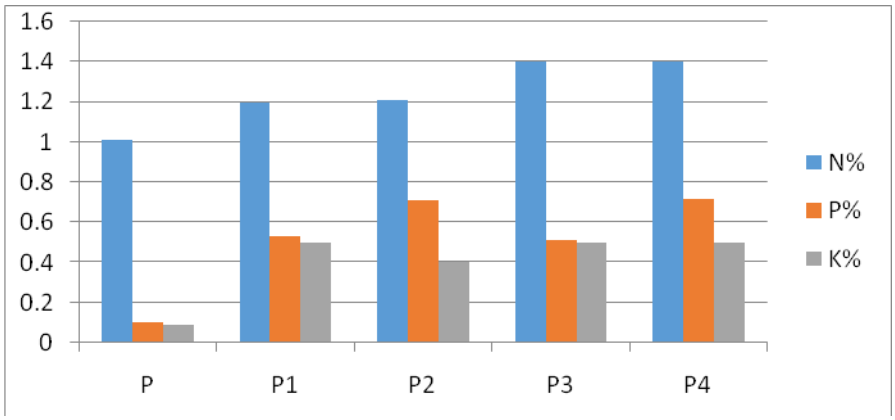

Figure 3: Concentration of N,P,K in plant parts grown in soil (P), Compost of MSW (P1), Compost of *Phumdi* (P2), Vermicompost of MSW (P3) and Vermicompost of *Phumdi* (P4).

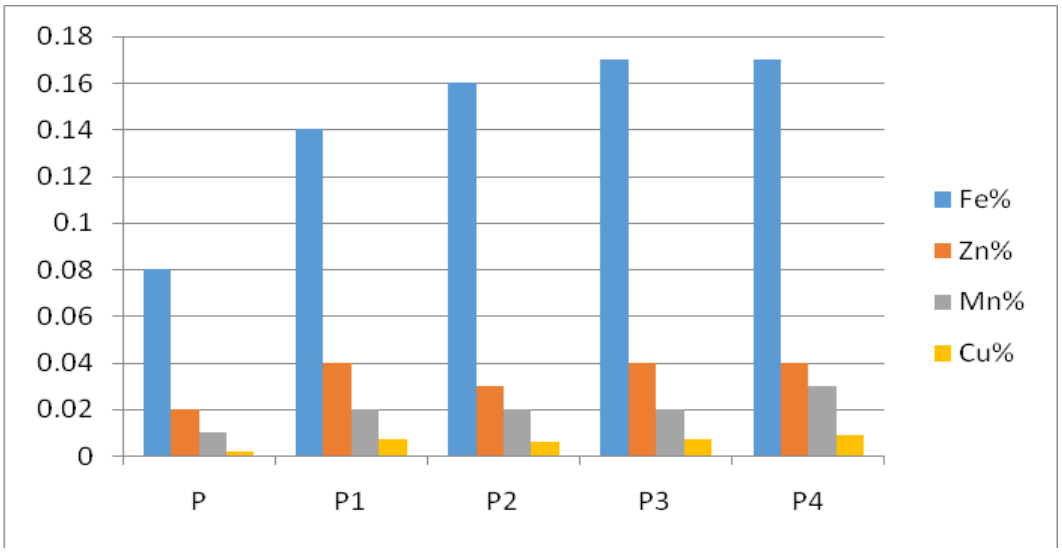

Figure 4: Concentration of Fe, Zn, Mn, Cu in plant parts grown in Soil (P), Compost of MSW (P1), Compost of *Phumdi* (P2), Vermicompost of MSW (P3) and Vermicompost of *Phumdi* (P4).

Concentration of Iron also increases from 0.08, 0.14, 0.16, 0.17 and 0.17respectively in P, P1, P2, P3 and P4. Presence of Zinc is high in all the three plant biomass P1, P3 and P4, i.e.(0.04 each) and reduces to 0.03 and 0.02 in P2 and P. Manganese content is highest in P4 (0.03),then reduces to 0.02 each in P1, P2 and P3,with a lowest value of 0.01 in P. Copper concentration found highest inthe plant biomass P4 with 0.07percent,the second highest in P1 and P3 with 0.007 percent and lowest record in P having 0.002percent (Figure 4).

Growth and yield parameters

There was a gradual increase in mean plant height (cm) in treatments S1, S2, S3 and S4, having 68.3±1.23, 81.3±0.94, 81.6±2.88 and 86.6±2.88 respectively from the S. Similarly, root length increases from S (21.3±1.24), to S1 (32±1.63), S2 (32.6±2.35), S3 (33) and S4 (41±2.05). The mean stem diameter was also observed to be significantly higher in the four treatments (0.86±0.05, 0.96±0.05, 1.13±0.05 and 1.13±0.05) than control (0.56±0.05).

Table 3: Growth Parameters of King Chilli grown in different medium of soil, compost and vermicompost medium.

Parameters	S	S1	S2	S3	S4
Shoot Length(cm)	49.6 ± 1.52	68.3 ± 0.47	81.3 ±0.94	81.6 ± 2.88	86.6± 2.88
RootLength(cm)	21.3 ±1.24	32 ± 1.63	32.6 ± 2.35	33 ±0	41 ± 2.05
Mean Stem Diameter(cm)	0 .99±0	1.13 ± 0.05	1.13 ± 0.05	1.14 ± 0.05	1.15 ± 0.05
Yield Non-marketable(gm)	3 ± 1	17 ± 2.64	17 ± 2.73	19 ± 1	19 ± 1
Marketable Yield (gm)	8 ± 1	21 ± 1.73	20.6 ± 1.52	21 ± 1.52	26 ± 2

Harvesting was done on 150th day. The highest average shoot length of 86.6cm (86.6±2.88) was noted in the plants treated with vermicompost of *Phumdi* followed by the average shoot length81.6cm (81.6 ± 2.88)in S3 and 81.3cm (81.3 ± 0.94) in S2, 68.3 cm (68.3 ± 0.47) in S1 and 49.6 cm (49.6 ± 1.52) in S. The result indicates that applications of vermicompost of MSW and *Phumdi* (S3 and S4) had a significant effect on the shoot length of King chilli. The maximum average root length 42.3 cm (42.3 ± 2.05) and 32.6 cm.Picture 1 shows the growth ofKing-chilli(60days), Picture 2 shows the fruits of King chilliin*Phumdi*(150 days) whereas Picture 3 depicts the fruits of King chilliin MSW medium (150 days) (Table 3).(32.6 ± 2.35) were observed in plants treated with vermicompost and compost of *Phumdi*, followed by 32 cm (32 ±1.63), 30 cm and 21.3 cm (21,3 ± 1.24) in S1, S4 and S.

The maximum average mean stem diameter of 1.15 cm (1.15 ±0.05)were observed in S4,followed by 1.14 cm (1.14 ± 0.05), 1.13 cm (1.13 ±0.05) in S2 and S1 whereas S has least diameter of 1.1 cm (1.1 ± 0.05) (Figure 5) Number of fruits both marketable and non-marketable were maximum 26 (26 ±2), 21(21 ±1.52), and 19(19 ± 1) in vermicompost of *Phumdi* and MSW followed by compost of *Phumdi* and MSW i.e.20.6(20.6 ± 1.52), 21(21 ± 1.73) and 17(17 ± 2.64)(17 ±1.73). Least number of fruits were observed in control (8±1 and 3±1). The number of fruits/plant in the four treatments C1, C2, C3 and C i.e.38.4, 37.7, 40.2 and 45.3 increased significantly, then those in control (11.2) in (Figure 6).

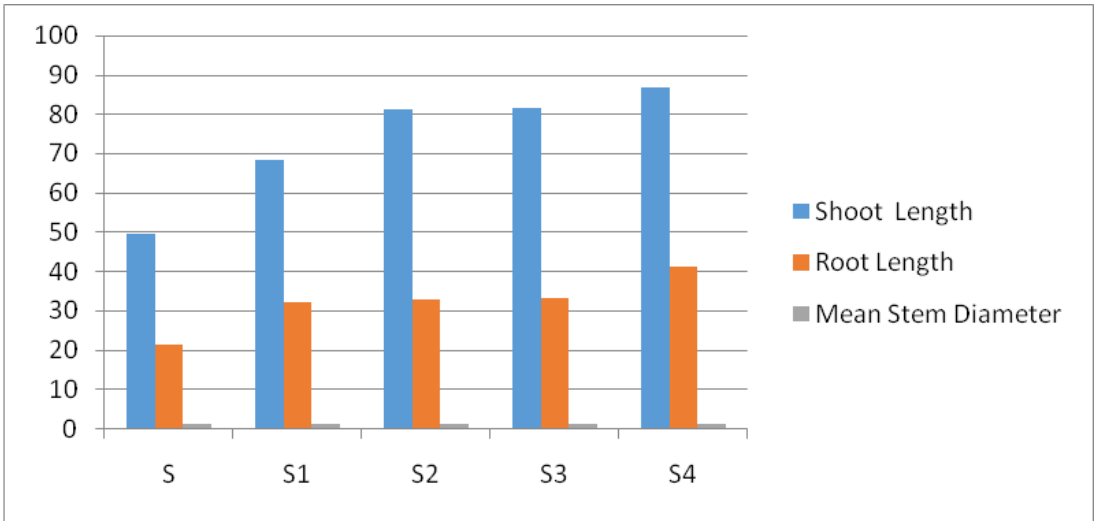

Figure 5: Growth rate of King Chilli plant grown in different medium, Shoot length,Rootlength, mean stem diameter in S, S1, S2, S3 and S4.

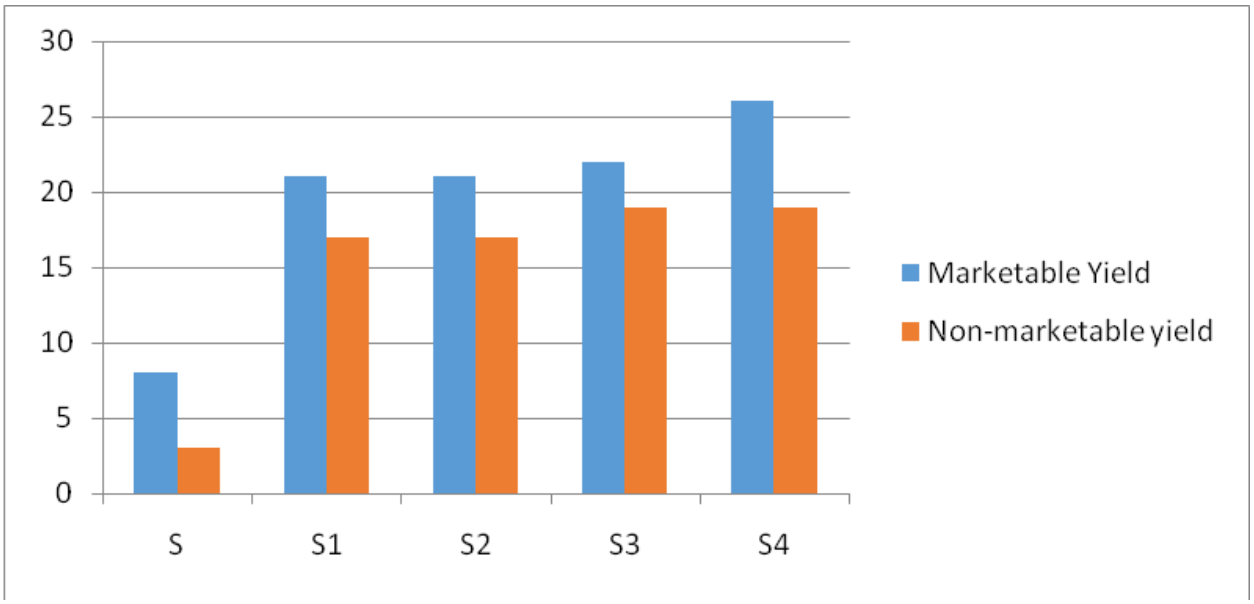

Figure 6:Fruit Yield of King Chilli Plant (marketable and non-marketable) grown in different treatments S, S1, S2, S3 and S4.

Picture 1:60 days old King Chilli in soil, compost of *Phumdi* MSW and vermicompost of *Phumdi* & MSW.

Picture 2:150 days old King Chilli in the vermicompost of Phumdi.

Picture 3: 150 days old King chilli in the vermicompost of MSW.

CONCLUSION

From the above result, it has been observed that vermicompost have a rich nutrient of nitrogen, phosphorus, potassium, iron, zinc, manganese and copper. The percentage of nutrients are higher in vermicompost when compared to compost. King Chilli plants grown in vermicompost mixed with soil shows highest growth parameters followed by plants grown in compost and soil medium while less plant growth was found in soil. Thus, it can be concluded that application of vermicompost in the soil increases the nutrients in soil and plants shows more growth and produce higher yields. The finding is similar with the findings of Adhikari et al. [17] with their statement that vegetative growth of the chilli plant increases in vermicompost treated plants when compared with compost. To produce crops of high nutritive value and zero chemicals, farmers and growers start using compost and vermicompost in place of chemical fertilizer. This practice should be encouraged by everyone in order to get a rich food at a reasonable rate all the year round.

ACKNOWLEDGEMENT

The authors expressed their sense of gratitude and thankfulness to the scientists and the staffs of the ICAR, Lamphel, Imphal, for providing necessary experimental facilities and valuable suggestions while carrying out the experimental analysis in their labs for writing this paper.

REFERENCES

[1] Ngasepam TM, Singh AK, Singh BK. 2016. Recent advances in naga king chilli (*capsicum chinense* JACQ.) research.12, 15-23

[2] Bindumadhabi G, Bhattiprolu SL. 2011. Integrated Disease management of dry root rot of Chilli incited by Sclerotium rolfsii (SAAC). International Journal of Plant, Animal and Environmental Sciences 1: 31-37.

[3] Parthasarathi K, Ranganathan LS. 2002. Supplementation of pressmudvermicast with NPK enhances growth and yield in leguminous crops (*Vignamunga* and *Arachis hypogaea*). J. Curr. Sci 2: 35-41.

[4] Chaoui I, Zibiliske M, Ohno T. 2003. Effect of earthworms cast and compost on soil microbial activity and plant nutrient availability. Soil Biol. Biochem 35: 295-302.

[5] Sasmita Panda, Gagan Kumar Panigrahi, Surendra nath Padhi. 2016. Earning Animals, Hamburg, Anchor Academic Publishing.

[6] Atiyeh RM, AranconNQ, Edwards CA, 2000. Influence of earthworm processed pig manure on the growth and yield of greenhouse tomatoes. Bioresour. Technol 75: 75-180.

[7] Wahyuni Y, Ballester AR, Sudarmonowati E, 2013. Secondary Metabolites of *Capsicum Species* and Their Importance in the Human Diet. Journal of Natural products 76: 783-793.

[8] Joshi R, Vig AP. 2010. Effect of vermicompost on Growth, Yield and Quality of Tomato (*Lycopersicum esculentum* L). African Journal of Basic & Applied Sciences 2: 117-123.

[9] Rao KR, Mushan LC,Khatavkar RS, 2010. Effect of vermicompost on the growth and yield of onion (*Alliumcepa*)Karnataka J. Agric. Sci 23: 361-363.

[10] Arancon NQ, Edwards CA, Bierman P, 2014. The influence of vermicompost applications to strawberries: Part 1. Effects on growth and yield. Bioresour. Technol 93: 145-153.

[11] Tomati U, Grappelli A, Galli E. 1988. The hormone like effect of earthworm casts on plant growth. Biol. Fertil. Soils 5:288-294.
[12] Swati Pattnaik, M vikram Reddy. 2010. Nutrient status of vermicompost of Urban Green Waste Processed by Three Species-*Eisenia fetida, Eudriluseugeniae*, and *Perionyx excavatus*. Applied and Environmental Soil Science: ID 967526.
[13] JacksonML. 1973. Soil Chemical analysis, Prentice Hall of India Private Limited, New Delhi, India, 1st edition..
[14] Anderson JM, Ingram JSI. 1993. Soil organic matter and organic carbon, in Tropical Soil Biology and Fertility: A Hand Book of Methods, J.M. Anderson and J.S.I. Ingram, Eds. CAB International, Wallingford, UK.
[15] SimardRR. 1993. Ammonium acetate extractable elements in Soil Sampling and Methods of Analysis, R. Martin and S. Carter, Eds: 39-43.
[16] Chapman HD, Pratt PF. 1961. Methods Of analysis for soil, plants and waters. University of California, Los Angeles 60: 150-179.
[17] Adhikary SP, Gantayet PK. 2012. Studies on the influence of organic fertilizers on the growth and some biochemical parameters of Chilli (*Capsicumannum* L. Var) The Bioscan 2: 255-258.

INTERNATIONAL JOURNAL OF PLANT, ANIMAL AND ENVIRONMENTAL SCIENCES

ISSN 2231-4490

International Journal of Plant, Animal and Environmental Sciences