

Life Science: Research, Practices and Application for Sustainable Development

Editors:
Dr P Ponmurugan
Dr V Ramasubramanian
Dr T Marimuthu



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Dr P Ponmurugan

Associate Professor
Department of Botany
Bharathiar University
Coimbatore – 641 046, Tamil Nadu, India.
E-mail: ponmurugan@buc.edu.in

Dr V Ramasubramanian

Associate Professor
Department of Zoology
Bharathiar University
Coimbatore – 641 046, Tamil Nadu, India.
E-mail: vraman68@rediffmail.com

Dr T Marimuthu

Secretary
National Academy of Biological Sciences &
Additional Director
World Noni Research Foundation
Chennai – 600 096, Tamil Nadu, India.
E-mail: secretarynabs@gmail.com



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Recent trends in Life Science

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Editors

Dr. P. Ponmurugan

Dr. V. Ramasubramanian

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LIST OF FULL LENGTH PAPERS

ISOLATION AND IDENTIFICATION OF PLANT GROWTH PROMOTING BACTERIA FROM RHIZOSPHERE OF PEANUT (<i>ARACHIS HYPOGAEA</i> L.) <i>M. Agila, P. Radha Priya, Dechen Khando, Mangai and P. Palani</i>	1
EFFECT OF SALT STRESS ON TOTAL CHLOROPHYLL CONTENT IN <i>LEUCAS ASPERA</i> <i>K. Agnes Nirmala and M. Kanchana</i>	7
TALC BASED FORMULATION OF CHINESE CATERPILLAR FUNGUS, <i>OPHIOCORDYCEPS SINENSIS</i> [BERK.] AGAINST <i>FUSARIUM</i> SPP <i>S. B. Akshaya, A. S. Krishnamoorthy, and C. Sangeetha</i>	10
PREPARATION OF VERMICOMPOST AND ITS IMPACT ON PLANT GROWTH (<i>VIGNA UNGUICULATA</i>) <i>Akshita Devanga, S. Preetheswari, A. Anjalai, P. Kathireswari and K. Saminathan</i>	13
<i>LACTOBACILLUS FERMENTUM</i> : A POTENT PROBIOTIC WITH IMMUNE MODULATORY HEALTH BENEFITS <i>Ann Catherine Archer, S.P. Muthu Kumar, and M.H. Prakash,</i>	18
ANTIMICROBIAL EFFICACY OF SILVER NANOPARTICLES SYNTHESISED FROM MARINE ACTINOMYCETES – <i>STREPTOMYCES</i> SPP <i>N. R. Arshiya Khan and J. Immanuel Suresh</i>	24
ISOLATION AND CHARACTERIZATION OF RESISTANT <i>STREPTOCOCCUS MUTANS</i> FROM DECAYED TOOTH SAMPLES <i>S. Ashokraj and V. Brindha Priyadarisini</i>	29
MOLECULAR PHYLOGENETIC ANALYSIS OF PULMONATA (GASTROPODA) BASED ON 16S, 18S & 28S RDNA SEQUENCE INFORMATION <i>Vijaya Sai Ayyagari and Krupanidhi Sreerama</i>	37
POTENTIALITY OF <i>SUAEDA MARITIMA</i> (L.) DUMORT. A SALT MARSH HALOPHYTE ON BIOACCUMULATION OF HEAVY METALS FROM TANNERY EFFLUENT <i>D. Ayyappan, G. Sathiyaraj, Zakir Hussain Malik and K. C. Ravindran</i>	40
DIVERSITY AND UTILIZATION OF PLANT SPECIES IN HOMEGARDENS OF LOKAMALESWARAM VILLAGE, KODUNGALLUR, THRISSUR, KERALA <i>E.C. Baiju, K.J. Arya and P.P. Mini</i>	48
IDENTIFICATION OF BIOACTIVE COMPOUNDS FROM ETHYL ACETATE EXTRACT OF ACTINOMYCETES ISOLATED FROM VERMICAST SOIL <i>R. Balachandar, N. Karmegam and J. Praburaj</i>	62
TAILORED PHOP GENE AS A POTENT THERAPEUTIC TOOL FOR MULTI DRUG RESISTANT <i>SALMONELLA</i> SPP. ISOLATED FROM VARIOUS GEOGRAPHICAL REGIONS IN TAMIL NADU <i>G. Balasubramaniand M. Marudhamuthu</i>	71

EXOGENOUS AUXINS IMPROVE ADVENTITIOUS ROOTING AND ENHANCE SALT TOLERANCE IN PETUNIA HYBRIDA <i>Muthusamy Balasubramanian, Ramalingam Radhakrishnan, Girija Shanmugam, Chang Kil Kim and Muthukrishnan Arun</i>	77
STUDY ON HABITAT CONDITIONS OF FEW BIRD SPECIES AT MYSORE DISTRICT, KANRATAKA, INDIA <i>S. Basavarajappa and H.S. Shruthi</i>	83
EFFECT OF <i>SACCHROMYCES CEREVISAE</i> ON REDUCTION OF METHANE EMISSION IN PADDY STRAW BASED TOTAL MIXED RATION FOR SUSTAINABLE PRODUCTION IN DAIRY CATTLE <i>A. Bharathidhasan</i>	90
EVOEVOLVING CONNEXIONIST SYSTEM (ECOS) SCHEME FOR EARLY PLAQUE DETECTION IN CORONARY ARTERY <i>Bharath Ganesan</i>	95
POTENTIAL PROTECTIVE EFFECT OF MANGIFERIN ON ANTILEUKEMIC DRUG ARSENIC TRIOXIDE INDUCED HISTOLOGICAL CHANGES, OXIDATIVE STRESS, IMPAIRED HEART AND LIVER FUNCTIONS IN WISTAR RATS <i>Binu Prakash, and Raveendran Harikumar Nair</i>	100
HYDROBIOLOGICAL ANALYSIS AND ITS INFLUENCE ON THE MYCODIVERSITY OF APPA ISLAND IN THE GULF OF MANNAR, EAST COAST OF TAMIL NADU <i>R. Carmel Mary and A. Panneerselvam</i>	108
POLYMORPHISM OF <i>IGF1</i> GENE AND THEIR ASSOCIATION WITH GROWTH RATES IN MECHERI SHEEP BREED <i>R. Chitra, V. Senthilkumar, M. Prabu, R.S. Kathiravan and A. Kirubakaran</i>	115
EFFECT OF INCREASING CONCENTRATIONS OF CADMIUM ON GROWTH, BIOCHEMICAL AND PHENOLIC ACID CONTENTS OF HORSE GRAM <i>K. Chitra</i>	120
STUDIES ON THE PHYSIO-CHEMICAL PROPERTIES OF THE OOTY LAKE <i>R. Christy Shaila, M. Manimegalai and P. Kathireswari</i>	126
<i>IN SILICO</i> EVALUATION OF ANTI-MALARIAL AGENTS FROM AS INHIBITORS OF <i>PLASMODIUM FALCIPARUM</i> LACTATE DEHYDROGENASE (<i>PFLDH</i>) ENZYME <i>J. Devakumar and S.S. Sudha</i>	130
TIME-MORTALITY RELATIONSHIP BETWEEN DNA UNVACCINATION AND VACCINATION OF RECOMBINANT VIRAL PROTEINS (VP19 AND VP28) AGAINST WSSV IN MARINE ORNAMENTAL SQUAT SHRIMP THOR AMBOINENSIS <i>N.S. Dhanasekaran and V. Priya lakshmi</i>	137
PERFORMANCE EVALUATION OF SOLAR PHOTOVOLTAIC (SPV) POWERED VAPOR COMPRESSION REFRIGERATION SYSTEM <i>A. J. Dhondge and S.R. Kalbande</i>	140

EFFICACY OF DIFFERENT INSECTICIDES AGAINST CASHEW STEM AND ROOT BORER, <i>PLOCAEDERUS FERRUGENIUS</i> L. (COLEOPTERA: CERAMBYCIDAE) <i>S. Jaya Prabhavathi, D. Keisar Lourdusamy, S. Vincent and M. S. Aneesa Rani</i>	222
PHYSICO – CHEMICAL AND BACTERIOLOGICAL PROPERTIES OF POTABLE WATER IN TWO TALUKS OF KANYAKUMARI DISTRICT <i>S. Jayakumar and D. Moni</i>	227
NEW BACTERIAL STRAINS FROM RIVER KAVERI, KODAGU, KARNATAKA <i>M. Jayashankar and Krishna</i>	231
ISOLATION AND IDENTIFICATION OF BIOSURFACTANT PRODUCING <i>BACILLUS</i> SP. <i>A. S. Jayasree, D. Latha and V. Muthu Laxmi</i>	241
MOSQUITOCIDAL PROPERTIES OF <i>SYZYGium LINEARE</i> (MYRTACEAE) AGAINST MEDICALLY IMPORTANT MOSQUITO VECTORS <i>A. Jeyasankar and S. Gandhimathy</i>	245
BIODIVERSITY AND ECOLOGICAL CATEGORY OF EARTHWORMS IN PERIYA OF WAYANAD FOREST DIVISION, KERALA <i>Jijo George, M. P. Deepthi, K. Saminathan and Kathireswari</i>	251
DIVERSITY OF PLANT ASSOCIATED BACTERIA ISOLATED FROM DIFFERENT MEDICINAL PLANTS AND THEIR ANTAGONISTIC POTENTIAL AGAINST WILT CAUSING PLANT PATHOGENS FUSARIUM OXYSPORUM AND RALSTONIA SOLANACEARUM <i>Jinal H. Naik and Natarajan Amaresan</i>	254
DESIGN AND EVALUATION OF BIOMASS COMBUSTOR CUM HOT AIR GENERATOR RETROFITTED WITH SOLAR TUNNEL DRYER <i>S. R. Kalbande</i>	259
IDENTIFICATION OF SATURATED HYDROCARBONS FROM JASMINE (<i>JASMINUM SAMBAC</i> L.) BUDS DAMAGED BY GALLERYWORM, ELASMOPALPUS JASMINOPHAGUS HAMPSON THROUGH GC-MS ANALYSIS <i>I. Merlin Kamala and J.S. Kennedy</i>	268
BIOSYNTHESIS OF SILVER NANO PARTICLES FROM MARINE ACTINOMYCETES AND THEIR EFFICACY AGAINST BACTERIAL ISOLATES FROM THE PUS OF DIABETIC FOOT ULCER <i>N. Kandanila, J. Immanuel Suresh and K. Satheesh Kumar</i>	277
FASCIATION IN <i>MERREMIA TRIDENTATA</i> (L.) HALLIER. F. - CONVULVULACEAE <i>I. Kanivalan, M. Parthipan and A. Rajendran</i>	281
DENDRIMERS: A TINY REVIEW ON BIOMEDICAL APPLICATIONS <i>Ayyavoo Kannan</i>	283
PRELIMINARY PHYTOCHEMICAL ANALYSIS AND ANTIBACTERIAL POTENTIAL OF LEAF EXTRACTS OF <i>COUROUPITA QUINENSIS</i> <i>A. Karthi and S. Premalatha</i>	287

MOLECULAR CHARACTERIZATION OF HEPATITIS B VIRUS (HBV) GENOTYPES IN IRULA TRIBAL POPULATION, TAMIL NADU, INDIA <i>E. Ramya, S. Ramalakshmi, P. Rajendran, S. P. Thyagarajan, Joseph C. Daniel and P.V. Geetha</i>	516
CARBON SEQUESTRATION AND DIVERSITY ASSESSMENT IN MANGROVE ECOSYSTEM OF THRISSUR DISTRICT, KERALA, INDIA <i>C.R. Remya Krishnan, C. N. Sunil, E.C. Baiju and P. P. Salma</i>	524
EFFECT OF COPPER ON AQUATIC MACROPHYTE (<i>PISTIA STRATIOTES</i> . L) <i>N.M. Rolli and R. B. Hujaratti</i>	530
A PRELIMINARY STUDY ON THE POLLEN FLORA OF MAHATMA GANDHI GOVT. ARTS COLLEGE, MAHE, U.T. OF PUDUCHERRY, INDIA <i>S. M. Safwana, K. Sasikala and M. Reema Kumari</i>	535
THREATENED MEDICINAL TAXA IN NILGIRIS BIOSPHERE RESERVE, WESTERN GHATS OF TAMILNADU, INDIA <i>P. Samyudurai, C. Rajasekar, A. Rajendran, S. Jeevith and M Saradha</i>	542
COMAPARITIVE STUDY ON EARTHWORM REPRODUCTIVE POTENTIAL OF <i>EUDRILUS EUGINIAE</i> USING DIFFERENT MEDIA <i>T. Sandra Rajan, M. P. Deepthi, K. Saminathan, and P. Kathireswari</i>	545
DIVERSITY OF AGARIC MYCOTA IN PALAMALAI HILLS WESTERN GHATS OF TAMILNADU <i>S. Santhoshkumar, N. Nagarajan, P. Samyudurai, and K. Shanmugasundaram</i>	548
DIVERSITY AND DISTRIBUTION OF ORCHID SPECIES IN EASTERN GHATS OF TAMILNADU, INDIA <i>M. Saradha,a G. Divya Bharathia and P. Samyuduraib</i>	553
OPTIMIZATION OF ULTRASONIC PRETREATMENT OF LEATHER INDUSTRY EFFLUENT FOR BIOMASS PRODUCTION OF <i>SCENEDESMUS QUADRICAUDA</i> KÜTZ <i>Sarumathi and K. Dhandayuthapani</i>	556
IN VIVO STUDIES ON THE ANTHELMINTIC EFFICACY OF ETHANOL EXTRACT OF <i>SYZYGIUM AROMATICUM</i> AGAINST <i>HAEMONCHUS CONTORTUS</i> <i>S. Sathish Kumar, L.Veerakumari, and Soundarajan</i>	563
MARINE <i>ACTINOMYCETES</i> AS AN EFFECTIVE BIOCONTROL AGENT AGAINST <i>RHIZOCTONIA SOLANI</i> - A PROMISING SUSTAINABLE ECOFRIENDLY ALTERNATIVE TO SYNTHETIC FUNGICIDES <i>B. Sathya Priya and T. Stalin</i>	571
PRODUCTION OF ECOFRIENDLY ALTERNATIVE TEXTILE DYES USING NOVEL ACTINOMYCETES <i>B. Sathya Priya,a T. Stalin,b V. Karthicka and S. L. Soundryaa</i>	574
TOXICITY ANALYSIS ON EDYSONE AGONIST, CHROMAFENOZIDE IN <i>SPODOPTERA MAURITIABOISD</i> (LEPIDOPTERA: NOCTUIDAE) <i>K. P. Sathyakala, C. Ayishabanu, Praseeja Cheruparambath, V. Reshma and E. M. Manogem</i>	577

A COMPARATIVE STUDY ON THE OIL CONTENT OF SEED OF THREE INDIAN <i>GARCINIA</i> SPECIES <i>Satyanshu Kumar, Raghuraj Singh, Azazahemad A. Kureshi, Premlata Kumari, Tushar Dhanani, Tabaruk Hussain, P C Baruah, Madhumita Talukdar and Amit Balwant Mirgal</i>	584
FLASH FLOOD IN CHENNAI AND THE FUTURE TREND <i>Masilamani Selvam, A. Chandini, G. Vyshnavi and B. Devipriya</i>	588
APPLICATION OF LOW-COST ADSORBENT FOR THE HEAVY METAL TREATED <i>LYCOPERSICUM ESCULENTUM</i> MILL. <i>P. Selvarathi and R. Murugalakshmi Kumari</i>	593
FACTORS INFLUENCING ECONOMIC LOSS DUE TO KETOSIS IN DAIRY ANIMAL <i>V. Senthil kumar, A. Mohamed Safiullah, G. Kathiravan, M. Prabu and R. Chitra</i>	598
EFFECT OF ADHATODA VASICA, CHROMOLAENA ODORATA, AND CLITORIA TERNATEA EXTRACTS AS AN IMMUNOSTIMULANT AGAINST AEROMONAS HYDROPHILA AND PSEUDOMONAS AERUGINOSA IN ORNAMENTAL FISH DANIO RERIO <i>V. Ramasubramanian and M. S. Shabana</i>	601
RARE MEDICINAL PLANT DIVERSITY IN CHITTERI HILLS, DHARMAPURI DISTRICT, EASTERN GHATS OF TAMILNADU, INDIA <i>K. Shanmugasundaram, S. Santhosh kumar and N. Nagarajan</i>	608
THE NUTRIENT DYNAMICS OF TERMITES MOUND SOIL AND ADJACENT SOILS <i>V. Sijina, M. P Deepthi, R. Chisty Shaila, K. Saminathan and P. Kathireswari</i>	610
A COMPARATIVE STUDY ON BIOLEACHING OF NICKEL AND CHROMIUM BY <i>ACIDITHIOBACILLUS FERROXIDANS</i> FROM ELECTROPLATING INDUSTRIAL CONTAMINATED SOIL <i>Hemalatha Sivasubramaniam, Karthika Ravichandran, Swathy Thiagarajan and Bharath Ganesan</i>	613
INVESTIGATION ON HEAT TRANSFER MECHANISM OF DOUBLE BASIN SOLAR STILL INTEGRATED WITH VACUUM TUBES <i>S. D. Deshmukh, S. R. Kalbande and V. P. Khambalkar</i>	619
CHARACTERIZATION OF EUKARYOTIC TRANSLATION INITIATION FACTOR 5 ALPHA IN <i>ORYZACOARCTATA</i> UNDER ABIOTIC STRESS <i>Soni Chowrasia, Alok Kumar Panda, Hukum Rawal, Abhishek Majumdar, Harmeet Kaur and Tapan Kumar Mondal</i>	625
STUDIES ON THE IMPACT OF TREE CANOPY COVER ON HERBACEOUS VEGETATION STRUCTURE AND ITS INFLUENCE ON THE REPRODUCTIVE SUCCESS OF AN EXOTIC WEED <i>LANTANA CAMARA</i> AT KARANTHAMALAI HILLS OF TAMIL NADU <i>N. Soundararajan, N. Kamaladhasan, S. Saravanan, B. Parthiban and S. Chandrasekaran</i>	632
EFFECT OF ANTENNAL ABLATION ON MATING AND OVIPOSITION BEHAVIOUR OF <i>PLUTELLA XYLOSTELLA</i> L. (LEPIDOPTERA: PLUTELLIDAE) <i>M. Soundarya, G. Gowri and K. Manimegalai</i>	638

PREPARATION OF VERMICOMPOST AND ITS IMPACT ON PLANT GROWTH (*VIGNA UNGUICULATA*)

Akshita Devanga,¹ S. Preetheeswari,¹ A. Anjalai,¹ P. Kathireswari^{1*} and K. Saminathan²

ABSTRACT

Vermicompost enhance the nutrient uptake by the plants by increasing the permeability of root cell membrane, stimulating root growth and increasing proliferation of root hairs. Vermicompost have upper level of existing macronutrients and micronutrients like Carbon, Nitrogen, Phosphorous, Potassium, Magnesium and Calcium and derived from the waste and also rich in microbial population and diversity; predominantly fungi, bacteria and actinomycetes. The present paper endeavored to evaluate the impacts of plant growth by preparing a small vermicomposting unit using *Eudrilus eugeniae* and the vermicompost was collected and used in various concentrations with regular horticulture soil for the growth of cowpeas plant (*Vigna unguiculata*) and the results of germination rate, shoot and root growth and chlorophyll content was observed.

Introduction

Vermicomposts have beneficial effects on plant growth. It is used as soil additives to improve seed germination and enhanced the rates of seedling growth and development. It contains water soluble nutrients and is an excellent, nutrient rich organic fertilizer. The electrical conductivity of vermicompost was found to be increased, may be due to the presence of exchangeable Calcium, Magnesium and Phosphorus in the vermicast compared to the soil (Bhatnagar & Patta, 1996).

Earthworm is a segmented worm found in the Phylum Annelida. They are found living in soil, feeding on partially degraded organic matter. Earthworms have been long recognized by farmers as beneficial to soil and called “Friends of farmers” (Singh & Pillai, 1973). They play major role in the conversion of organic matter and improve the soil fertility. The compost prepared using earthworm is defined as a cost effective technology system for processing of biodegradable wastes (Hand *et al.*, 1988). In the process of feeding, earthworms fragment the waste substrate; enhance microbial activity and the rate of decomposition of the materials leading to a composting mechanism. The end product, commonly termed vermicompost rich in micro and macro nutrients, higher water holding capacity and microbial activity (Graff, 1971). Vermicompost increases the surface area, provides strong absorbability & retention of nutrients as well as retain more nutrients for a longer period of time.

Vermicompost enhance the nutrient uptake by the plants by increasing the permeability of root cell membrane, stimulating root growth and increasing proliferation of root hairs (Pramanik *et al.*, 2007). Vermicompost also aids in protecting crop plants against pests and diseases. The effects of vermicomposts on the growth of a variety of crops has been demonstrated and proved beneficial by various scientists like Edwards & Burrows (1980), Atiyeh *et al.* (1999). The greatest plant growth responses and yields have occurred usually when vermicompost constituted a relatively small proportion (10 – 40%) of the total volume of plant growth medium in which they are incorporated (Atiyeh *et al.*, 1999). Reddy and Reddy (1999) reported significant increases in micronutrients in the field soils after vermicompost applications compared to those in soils treated with animal manures.

The amounts of soil nutrients increased significantly after incorporating vermicomposts into soils reported by Kale (1992). Earthworms utilize microorganisms as their main source for degradation of the organic materials (Edwards and Fletcher, 1988), there are usually greatly increased numbers of bacteria, actinomycetes and fungi in freshly-deposited earthworm casts than in the surrounding soil (Edwards and Bohlen, 1996); which increases the microbial activity of vermicompost which may avoid pest attack to the plants. In our experiment we prepared the vermicompost in a small vermicomposting unit using *Eudrilus eugeniae* and the vermicompost was collected and used in various concentrations with regular horticulture soil for the growth of cowpeas (*Vigna unguiculata*) plant and the results were observed.

¹PG and Research Department of Zoology, ²Department of Chemistry Kongunadu Arts and Science College, Coimbatore-641029, Tamil Nadu, India. (Email: kathireswari@gmail.com)

Materials and Methods

Vermibed preparation:

The vermibed was prepared according to the method followed by the scientists in their experiments (Kale 2006), the vermicompost was obtained and utilized for the comparative study in different concentrations on Cowpeas (*Vigna unguiculata*) plant.

In order to test the effect of different combinations of vermicompost with soil on the growth of plants; fast growing cowpeas plant (*Vigna unguiculata*) was chosen. The seeds were collected from the seed shop in G. N. Mills, Coimbatore, Tamil Nadu.

Preparation of Substrate at different concentration:

The plants were grown in plastic bags used generally for saplings. Five bags in triplicates were utilized for this experiment viz. The five different combinations of substrates were used. The weight of substrate in single bag was 1 kg. The combinations used for plant growth as follows:

- (A) 100% horticulture soil
= 1 kg of red soil only
- (B) 25% vermicompost + 75% horticulture soil= 250g of vermicompost along with 750 g of red soil.
- (C) 75% vermicompost + 25% horticulture soil = 750g of vermicompost along with 250 g of red soil.
- (D) 50% vermicompost + 50% horticulture soil= 500g of vermicompost along with 500g of red soil.
- (E) 100% vermicompost = 1 kg of vermicompost only.

Seven seeds were sown in each substrate. Their germination rate was calculated and the difference in their growth was observed. The shoot height was measured every alternated day after germination. Chlorophyll content of each substrate plant was calculated. Shoot weight and root weight was also measured for the interpretation.

Germination test in percentage was calculated using the formula as described by the method Vavrek & Campbell (2002).

Percentage of germination =

$$\frac{\text{Number of seeds germinated} \times 100}{\text{Number of seeds sown}}$$

The Chlorophyll was extracted in 80% acetone & the absorption at 663nm & 645nm were read in a spectrophotometer. Using the adsorption coefficients, the amount of chlorophyll contents a, b & c was calculated. The chlorophyll estimation was carried out following the method of Aaron (1949). The results were represented in turns of mg/g.

The amount of chlorophyll present in the extract was calculated using following equation:

Mg chlorophyll a/g tonic =

$$\frac{12.7(A_{663}) - 2.69(A_{654}) \times V}{1000 \times W}$$

Results and Discussion

Germination rate and their chlorophyll content have been determined (Figure 1) and the germination rate is increased in 100% vermicompost when compared to the horticulture soil and other concentration of substrates.

The Chlorophyll content of the plant leaves was determined in different concentration of vermicompost as shown in Figure 2.

Green revolution is the result of boosting the production of yield during the time of food crisis. This has resulted in good harvests and more production and also have an adverse impacts on soil. Conditions and environment: The cheapest solution to overcome this adversity is to adopt the old agricultural methods and use natural, organic and economic practices like Vermitechnology. Biodegradable wastes broken down rapidly by earthworms, resulting in a stable non – toxic material with rich macro and micro nutrients which has a potentially high economic value as soil

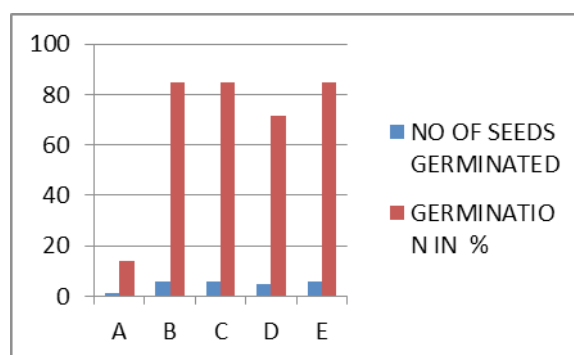


Figure 1. Germination Rate

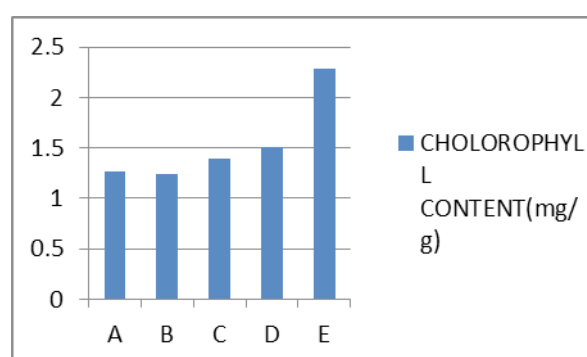


Figure 2. Chlorophyll content

conditioner for plant growth. Evidently as Edwards (1988) has reported that vermicompost could promote early and vigorous growth of seedlings in plants. Humic acid provides many binding sites for plant nutrient such as calcium, iron, potassium, sulfur and phosphorus in available form for plants uptake.

Supportively Russel (1909) has reported that earthworms decompose the organic matter quickly & increase the nitrification, which are responsible for increasing yield. Vermicompost increases the surface area and provides strong absorbability and retention of nutrients as well and retain more nutrients for a longer period of time. It is known that vermicompost enhances germination, plant growth and crop yield. It improves root growth and structure and enriches the soil with micro-organisms.

The present study supports that vermicompost accelerates germination process and biomass production & also that in 20-30% of vermicompost in combination to soil yield better result.

The plant showed different percentage of germination rate & growth and this may be due to the beneficial microorganisms, natural plant hormones, enzymes, balanced micro & macro nutrients. Nainawat (1997) observed that the addition of vermicast in different ratio increased crop production. The highest germination rate was found in 100% vermicompost substrate. The least rate was observed in 100% soil substrate. The presence of micro and macro nutrients and plant growth hormones may be the reason for fast germination in 100% vermicompost substrate.

The greatest plant growth responses and yields have occurred usually when vermicompost constituted relatively small proportions (10–40%) of the total volume of plant growth medium in which they are incorporated. Usually lesser proportions of vermicomposts substituted in plant growth give positive results than the higher proportions (Atiyeh *et al.*, 1999). The result of our studies is similar to the results provided by Atiyeh 1999, the best growth result was found in 75% soil + 25% vermicompost substrate.

The presence of nitrogen in soil and chlorophyll in plants are in direct proportion. Therefore chlorophyll may be used as an indirect indicator of nitrogen levels in fertilizer management. In our experiment the highest chlorophyll content was obtained in 100% vermicompost substrate, which indicates that vermicompost have high nitrogen content than the normal horticulture soil.

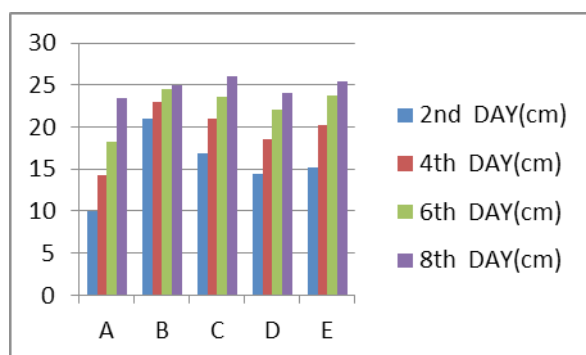


Figure 3. Shoot Height

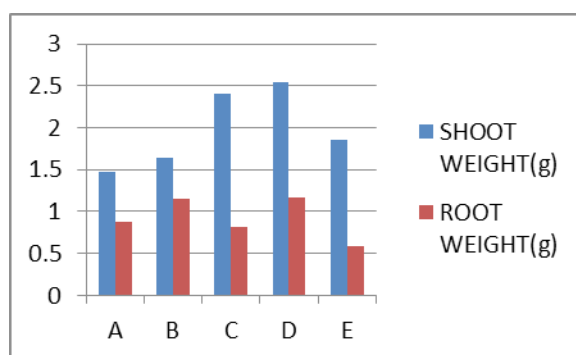


Figure 4. Shoot and Root weight

The plant shoot heights were also measured and showed the various results in different substrates (Figure 3). The best results were obtained in 25% vermicompost + 75% soil substrate. This shows that the mixture of 20 - 40% vermicompost in any soil will provide best results (Atiyeh, *et al.*, 1999). The nutrient level, especially the macro or micro – nutrients were found to be always higher in vermicompost than the compost derived from other methods (Kale, 1998). The biomass of the plant was higher in 50% vermicompost + 50% soil which indicates that the nutrients required for plant growth were equally provided by both the soil and vermicompost. (Figure 4).

Conclusion

Vermicompost can be used in organic farming to increase the crop yield and it is also economical to the farmers. There are many advantages of vermicompost regarding the plant growth which can be utilized in the field for commercial production.

From the present study we can conclude that 100% vermicompost is required for higher plant germination and 25% vermicompost is sufficient for the growth of the Cowpea plant.

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