INTERNATIONAL e- CONFERENCE

"SOIL ALIVE 2020"

5th December- 2020

EXTENDED SUMMARIES, ABSTRACT AND POSTERS

EDITORS

Dr.J.Revathi

Organized by

Department of Soil Science and Agricultural Chemistry

Palar Agricultural College

Ambur – 635 805

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International e- conference on "Soil Alive 2020"

PALAR AGRICULTURAL COLLEGE
A UNIT OF R. S. EDUCATIONAL AND CHARITABLE TRUST
(Affiliated To Tamil Nadu Agricultural University)
Kothamarikuppam Village, Melpatti (Post) – 635805, Vellore (Dist.).TN.

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CHAIRMAN

MESSAGE

"There can be no life without soil and no soil without life. They have evolved together"

Soil is the important basis for agriculture. Healthy soil can produce crops with more nutrients and it also improves the food quality. So, maintaining soil health is very important.

Increasing demand, and by the awareness of the environmental and human health damage induced by overuse of pesticides and fertilizers worldwide agricultural practice is moving to a more sustainable and environmental friendly approach. Organic matter is known to improve soil health and availability of plant nutrients. In recent years, soil application of organic wastes has emerged as an attractive and cost effective alternate strategy for wastes management around the world and that will helps to maintain the soil Alive and healthy. The composted or uncomposted organic waste material is applied in huge quantities to supply the required quantity of nutrients in agricultural systems and also to maintain the environmental healthy.

Soil has both Environmental impact and nutritional impact on human beings, as we are consuming food that comes from soil.

I feel elated that the Department of Soil Science and Agricultural Chemistry is organizing an e- Conference on **THE SOIL IS ALIVE 2020"** in commemoration with the celebration of **WORLD SOIL DAY 2020** in Palar Agricultural College, Ambur.

I wish to congratulate on the beautiful success of the e-Conference and heartiest greetings to the organizers in the occasion and wish the programme success.

Place: Melpatti
Date: 01.12.2020

(K.C.Veeramani)

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MESSAGE

Soil is one of the most valuable natural resources that cannot be replenished by man. Preservation and management of soil is of utmost importance as it sustains life. Irrigational use of soils in the recent past has resulted in soil fertility decline and soil health deterioration and has led on non judicious use of soils and irrigation water. Series of problems related to decline in soil quality and environment have been emerging and posing challenges to sustainable agricultural production.

On the eve of celebrating **WORLD SOIL DAY 2020**, the International e- conference on "**THE SOIL IS ALIVE 2020**"is aptly organized by the department of Soil Science and Agricultural Chemistry, Palar Agricultural College and the deliberations will help to evolve strategies for developing and promoting measures towards enhanced agricultural production and simultaneously preserving the soil resource base. The various themes are focused on issues related to soil health *viz.*, fertility, quality, deterioration and management, latest tools in upgrading soil health, protecting soils and conserving soil and environment and strategies towards long term land use planning and management.

Undoubtedly, the e- conference will emanate fruitful results. The proceedings is a compilation of extended summaries of research papers and abstracts from various parts of nation and am sure will provide knowledge on latest developments to research scientists, scholars, students and entrepreneurs who are concerned about soil and environmental health.

I place on record my best wishes to the organizers, faculty members and students of various committees towards the success of the International e- Conference.

Soil is life, Conserve it........!

Place: Melpatti
Date: 01.12.2020

(S.Srinivasan)

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Dr.Y.HARIPRASAD E- mail: *deanpac@tau.ac.in*

PRINCIPAL Phone no: 6383656366

MESSAGE

The theme of World Soil day 2020, according to the Food and Agriculture Organization (FAO) campaign, is "Keep soil alive, protect soil biodiversity". By encouraging people around the world to engage in proactively improving soil health, the campaign aims to fight soil biodiversity loss. If we do not act soon, the fertility of soil will continue to be adversely affected at an alarming rate, threatening global food supplies and food safety.

Due to injudicious use of synthetic pesticides and fertilizers most of our fields are contaminated with pesticides and toxic residues. These are highly harmful not only to non-target organisms but also to the human beings, causing serious health hazards. So to create awareness among the famers and to sensitize the students to remind their role to safe guard our precious fields and soil. It is ideal time to conduct the e conference in this juncture.

In this context, I am glad to inform that Department of Soil science and Agricultural Chemistry at Palar Agricultural College arranging one day International e-conference on "SOIL ALIVE."I congratulate the organizers I do believe the deliberations, interactions during the conference will be significantly useful to the students, researchers and other participants.

I extend my appreciations and best wishes for successful conduct of the e- conference.

Place: Melpatti
Date: 01.12.2020

(Y.Hariprasad)

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MESSAGE

"Soil – Its more important than you think……!"

Without healthy soils, life on earth would be unsustainable. Soils are the foundation of agriculture. They provide vital ecosystem services and the basis for food, feed, fuel, fibre and medical products important for human well-being.

Soil is also the largest pool of organic carbon, which is essential for mitigating and adapting to climate change. In an era of water scarcity, soils are fundamental for its appropriate storage and distribution. However, soil degradation is a rapidly increasing problem in all parts of the world. Some 33 per cent of global soils are already degraded through urbanization. Soil erosion, nutrient depletion, salinity, acidification and contamination are additional threats. For too long the world has taken soils for granted. But soil is a natural resource that is not easily renewed. Sustainable soil management should be a priority for all.

I feel delighted on the occasion of celebrating **WORLD SOIL DAY 2020** in the Department of Soil Science and Agricultural Chemistry, Palar Agricultural College, Ambur. And they organize an e – Conference on **"THE SOIL IS ALIVE 2020"**to encourage investment in sustainable soil management as a sound and affordable alternative to restoration and rehabilitation.

May this e- conference be characterized by fruitful thoughts and provoking discussions, which will leads to the betterment in the improvement of soil quality and environmental health. And I wish the organizers, member's success and good deliberations.

On World Soil Day, let us pledge to do more to protect this important yet forgotten resource. "***A healthy life is not possible without healthy soils"***.

Place: Melpatti
Date: 01.12.2020

(V.E.Madhu)

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INTERNATIONAL e – CONFERENCE on

"SOIL ALIVE 2020"

On the eve of world soil day 2020 celebrations
Department of soil Science and agricultural Chemistry
Palar Agricultural College, Ambur

PROGRAMME

10.00 AM	INTRODUCTION
10.05 AM	TAMIL THAI VAZHTHU
10.15 AM	WELCOME ADDRESS **Dr. J. REVATHI** ASSISTANT PROFESSOR (SS&AC), PALAR AGRICULTURAL COLLEGE
10.30 AM	FECILITATION **Dr.Y.HARIPRASAD** PRINCIPAL, PALAR AGRICULTURAL COLLEGE
10.45 AM	LECTURE ON " SOIL ALIVE INTERMS OF ANIMAL FEED" **Dr. SINEENART POLYORACH,** ASSOCIATE PROFESSOR KING MONGKUT'S INSTITUTE OF TECHNOLOGY LABDKRABANG, TAIWAN
11.15 AM	LECTURE ON " SOIL BIODIVERSITY" **Dr. M.PRABHAVATHY,** SCIENTIST (SOIL SCIENCE) INDIAN INSTITUTE OF SOIL AND WATER CONSERVATION, BELLARY, KARNATAKA
12.15 PM	LECTURE ON " SOIL BIOLOGY" **Dr. RATNA PRASAD** SENIOR PRINCIPAL SCIENTIST AND HEAD, REGIONAL AGRICULTURAL RESEARCH STATION, GUNTUR, ANDRA PRADESH
12.45 PM	LECTURE ON " SOIL ALIVE BUT IT'S HUNGRY" **Dr. J. REVATHI**, ASSISTANT PROFESSOR, DEPARTMENT OF SOIL SCIENCE AND AGRICULTURAL CHEMISTRY, PALAR AGRICULTURAL COLLEGE
01.00PM	LECTURE ON " THEIR SOIL" **Ms. E.NANDHINI**, ASSISTANT DIRECTOR OF HORTICULTURE, SATHANGULAM BLOCK, TUTICURIN DISTRICT
01.30 PM	COMPETITION FOR STUDENTS
02.30 PM	VOTE OF THANKS **Dr. J. REVATHI**, ASSISTANT PROFESSOR (SS&AC), PALAR AGRICULTURAL COLLEGE
03.00 PM	NATIONAL ANTHEM

CONTENTS

S8	**Effect of organic practices on available soil nutrient status in black pepper (*Piper nigrum* L.)** **RAVANACHANDAR A, AND V. LAKSHMANAN** Assistant Professor, Dept. of Horticulture, SRM College of Agricultural Science, SRM University, Chennai.	
S9	Total Nitrogen, Phosphorus and Potassium uptake by plants due to the Effect of Integrated Nutrient Management in Ashgourd (Benincasa hispida Cogn.) Cv. Co-1 **M. THANGAMUNIYANDI AND E. NANDHINI`** Department of Horticulture, Don Bosco College of Agriculture, Sagayathottam.	
	ABSTRACTS	
A1	**SOIL IS ALIVE BUT IT'S HUNGRY** **J.REVATHI,** DEPARTMENT OF SOIL SCIENCE AND AGRICULTURAL CHEMISTRY, PALAR AGRICULTURAL COLLEGE, AFFILIATED TO TAMIL NADU AGRICULTURAL UNIVERSITY	
A2	**SOIL HEALTH** **Mr.C.Anbarasu,** Assistant Professor, Department of Soil Science and Agricultural Chemistry, Palar Agricultural College	
A3	**THERI SOILS** **Ms. E. NANDHINI, Assistant Director of Horticulture, Sathankulam block, Tuticurin district**	
A4	**EFFECT OF INTEGRATED NUTRIENT MANAGEMENT IN CUCUMBER (*Cucumis sativus* L.)** Mr. M. THANGAMUNIYANDI, Assistant Professor, Department of Horticulture, Don Bosco College of Agriculture, Sagayathottam, Vellore district	
A5	Soil Biodiversity **Mr.D.Sasidharan,** Final Year, B.Sc, (Hons.) Agriculture, Palar Agricultural College	
A6	Soil Ecosystem **Ms.HARIPRIYA,** Final Year, B.Sc, (Hons.) Agriculture, Palar Agricultural College	
A7	Soil Science through the eyes of Artificial intelligence **Ms. J.YAAMINI,** Final year, B.Sc, (Hons.) Agriculture, Palar Agricultural College	
A8	Environmental soil quality and soil fertility **Mr.A.Vignesh**, Final Year, B.Sc,(Hons.) Agriculture, Palar Agricultural College	
A9	Sustainable soil management **Ms.P.Akila**, Final Year, B.Sc., (Hons.) Agriculture, Palar Agricultural College	

A10	Soil degradation; a global problem endangering sustainable development **Ms. V.Devayani,** Final Year, B.Sc,(Hons.) Agriculture, Palar Agricultural College	
A11	Soil health **Ms. CH.Tejaswi**, III. B.Sc, (Hons.) Agriculture, Palar Agricultural College	
A12	Soil Temperature **Mr.S.ARUN**, III B.Sc.(Hons.) Agriculture, Palar Agricultural College	
A13	Soil fertility Ms. S. Meena, III year B.Sc.(Hons.) Agriculture, Palar Agricultural College	
A14	Soil **Mr.S.VIMAL,** III B.Sc, (Hons.) Agriculture, Palar Agricultural College	
A15	Soil erosion **Mr. L.VIGNESH**, III B.Sc, (Hons.) Agriculture, Palar Agricultural College	
A16	Healthy soils for healthy life **Ms. J. ASWINI**, III.B.Sc, (Hons.) Agriculture, Palar Agricultural College	
A17	Soil biodiversity **Ms. R.MADHUMITHA,** III B.Sc. (Hons.) Agriculture, Palar Agricultural College	
A18	Soil fertility management **Ms. D.APARNA,** III year B.Sc, (Hons.) Agriculture, Palar Agriculture	
A19	Soil **Ms. A. SIVASANKARI**, III B.Sc. (Hons.) Agriculture, Palar Agricultural College	
A20	Soil aeration **Mr. V.YUVARAJ**.III B.Sc,(Hons.) Agriculture, Palar Agricultural College	
A21	Keep Soil Alive Protect Soil Biodiversity **MS. M. MANOMETHA**, III.B.Sc, (Hons.). Agriculture, Palar Agricultural College	
A22	Soil Profile **Mr.A.ARUNARASAN,** III B.Sc, (Hons.) Agriculture, Palar Agricultural College	
A23	Soil health **Mr.P.KAMLESHWARAN**, III B.Sc, (Hons.) Agriculture, Palar Agricultural College	
A24	Soil types in Kanyakumari district **Ms.V.ADLIN JEMIMA,** III B.Sc.(Hons.) Agriculture, Palar Agricultural College	
A25	Soils of Tamil Nadu **Ms.V.KEERTHANA,** III B.Sc, (Hons.) Agriculture, Palar Agricultural College	
A26	Soil alive **Mr.K.NAGAVENKATASAI**, II. B.Sc, (Hons.) Agriculture, Palar Agricultural College	

A27	Organic fertilizer vs. Chemical fertilizer and their impact on land **Ms. KAVIYA,** II B.Sc.(Hons.) Agriculture, Palar Agricultural College	
	POSTERS	
P1	Terra Firma **Ms.R.SENTHAMIZH**, Final Year, B.Sc,(Hons.) Agriculture, Palar Agriculture College	
P2	Soil Carbon Sequestration **Ms.R.ASWINI,** Final Year, B.Sc,(Hons.) Agriculture, Palar Agriculture College	
P3	Benefits of Volcanic eruption in soils **Ms.V.GAYATHRI,** Final Year, B.Sc,(Hons.) Agriculture, Palar Agriculture College	
P4	Explore soil erosion and How plants purify our water **Ms.N.MONISHA,** Final Year, B.Sc,(Hons.) Agriculture, Palar Agriculture College	
P5	Keep soil Alive protect Biodiversity **Ms.I.PRAVEENA,** Final Year, B.Sc,(Hons.) Agriculture, Palar Agriculture College	
P6	Soil – An Indispensible Entity **Mr.L.SRIRAM,** Final Year, B.Sc,(Hons.) Agriculture, Palar Agriculture College	
P7	Worlds Soils are Under Threat **Mr.S.NARESH,** Final Year, B.Sc,(Hons.) Agriculture, Palar Agriculture College	
P8	No soil No us **Mr.S.SANKARALINGESHWARAN,** Final Year, B.Sc,(Hons.) Agriculture, Palar Agriculture College	
P9	Soil Dirt **Ms. G.GOWTHAMI,** Final Year, B.Sc,(Hons.) Agriculture, Palar Agriculture College	
P10	Theme of World Soil Day 2020 **Mr. G.MUTHUKUMAR,** Final Year, B.Sc,(Hons.) Agriculture, Palar Agriculture College	

EXTENDED SUMMARIES

THE SOIL IS ALIVE: IN TERMS OF ANIMAL FEED

Sineenart Polyorach*

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Introduction

Soil occurs in layers, each of which has distinct composition and properties. The mineral portion comes from weathered rock. It provides essential nutrients for plants as well as pore spaces for water and air. To define soil health appropriately, "soil health" can be defined as "the state of the soil being in sound physical, chemical, and biological condition, having the capability to sustain the growth and development of land plants."

To appreciate the complexity of soil health in different agricultural systems, we have to learn about the components of the soil. Soil is composed of solid particles, developed through the soil-forming processes. These particles have different shapes and sizes, and are classified as sand, silt, or clay based on their size. Sand particles are the largest (0.05–2 mm), followed by silt (0.002–0.05 mm), while clay particles are the smallest (<0.002 mm). In between these particles, soils have pore spaces that can be filled with air and/or water, depending on the state of the soil (Figure 1). Soils with more sand will have larger pores compared to fine-textured or "heavy" soils, which will have smaller particles and smaller pores. The relative composition of sand, silt, and clay determines soil texture (Figure 2).

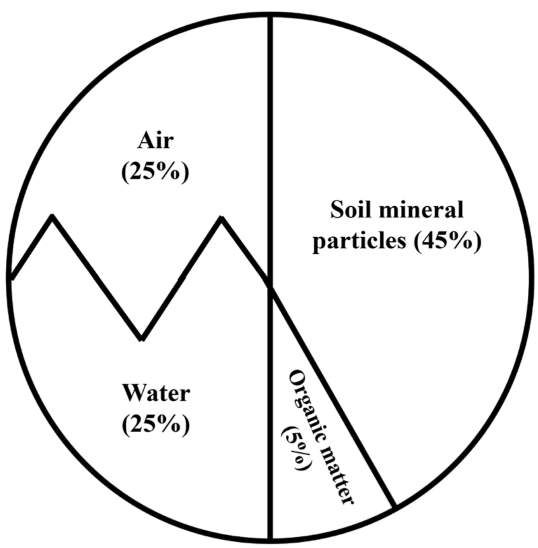

Figure1. Components of the soil, including mineral particles, water, air, and the soil organic matter.
Source: Idowu et al. (2020)

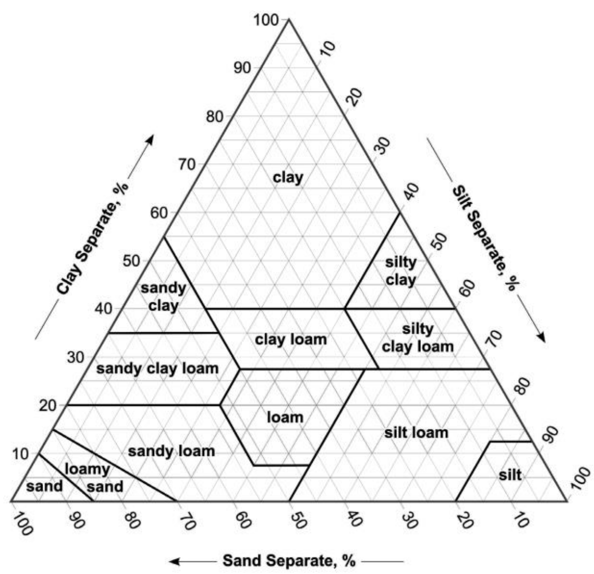

Figure 2. Soil textural triangle used for determining soil texture if the percentages of sand, silt, and clay are known.
Source: USDA Natural Resources Conservation Service (2018)

Soils have different textures based on the proportion of different-sized particles measured after removing the rocks, cobbles, and gravel larger than 2 mm. Textures range from sand, which has predominantly sand-sized particles, to clay, which has high percentages of very small particles. The soil particles make up about 45% of the volume of soil (Figure 1). A soil that is saturated with water will have no air in the pore spaces, while a soil that is dried out will have predominantly air in the pore spaces. The total pore spaces are about 50% in a soil with a very good structure (Figure 1). In an ideal cropping soil, the remaining 5% of soil would be made up of the soil organic matter, which is biological material at various stages of decomposition (Figure 1) (Idowu *et al.*, 2020)

Why soil is so important

Soil is a living thing, it is very slowly moving, changing and growing all the time. Just like other living things, soil breathes and needs air and water to stay alive. Healthy, living soil provides us with our everyday needs. Not only the obvious things such as food, grass, plants and trees but also sprouts Life Soil supports all kinds of living activities. It nourishes crops that we use for food and trees that we use for building materials. Wildlife and livestock survive by eating plants that grow on the soil. We build houses and roads on top of the soil.

Role of soil for animal feed

One of the most important functions that soil organisms perform is decomposition. Without decomposition, all the plants and animals that ever died would be piled up on top of the ground. Microorganisms break down animal wastes, fallen leaves, and the dead plants and animals. This process releases the carbon and nutrients used by the plants and animals back to the environment in forms that future generations of plants and animals can use. This is called soil-plant-animals cycling. Decomposition is just one way that soil organisms contribute to soil-plant-animals cycling. Some microorganisms also capture nitrogen from the atmosphere; this can be done independently or in partnership (through symbiosis) with leguminous plants. Legumes, like green beans and alfalfa, allow certain soil bacteria to live in their roots – to benefit from nitrogen that the bacteria captures from the air (Figure 3) (Sindelar, 2015).

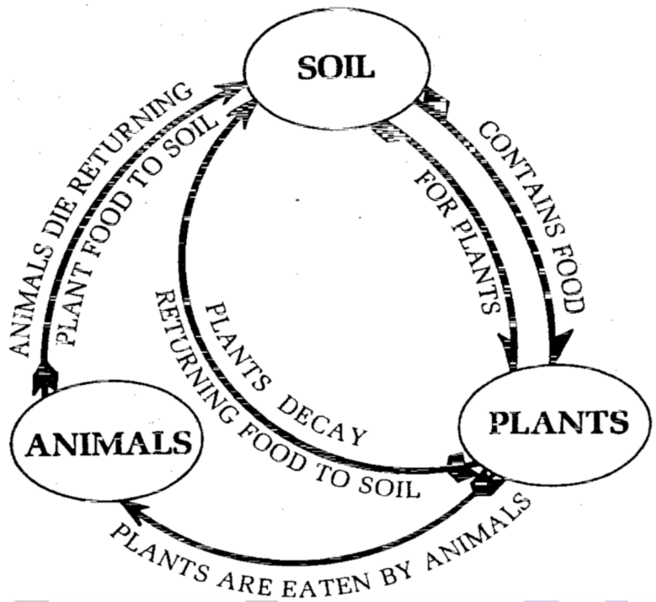

Figure 3 soil-plant-animals cycle.

Therefore, soil is very important role for animals feed. Healthy soil produced high quality and quantity of feed for animal (poultry, swine and ruminants productions), animals provide good food in terms of meat and milk for human (Figure 4). Moreover, adherence to good agricultural practices is encouraged in the production of natural, improved and cultivated pastures and in the production of forage and cereal grain crops used as feed or feed ingredients for food producing animals. Feed ingredient such as sorghum, corn, wheat, barley, soybean and sunflower seed, cassava root, and rice brain.

Forage crop, there were fodder three such as *Leucaena leucocephala, Gliricidia sepium, Sesbania sesban and Cajanus cajan*, grass such as Guinea grass (*panicum maximum*), Napier grass (*Pannisetum purpureum*), Napier grass (*Pannisetum purpureum*), Signal grass (*Brachiaria decumbens*), Legumes such as Cavalcade (*Centrosema pascuorum* cv. Cavalcade), Slender Mimosa (*Desmanthus virgatus*), Hamata (*Stylosanthes hamata* cv. Verano) and Thapra stylo (*Stylosanthes guianensis* CIAT 184).

Agro-industry agricultural by-products such as Rice straw, Pineapple peel, sugarcane bagasse, cassava hay, by-products from tapioca starch industry, by-products from caned sweet corn industry and west from durian fruit. The production of distilled spirits and beer, wheat processing, wet corn milling, and etc. Products from the production of spirits such as brewer's grains and/or distiller's grains can make excellent animal feedstuffs. There are also by-products from the wheat milling industry, such as wheat bran, middlings, reddog, shorts, and etc. By-products from wet corn milling give us high fructose corn syrup and a variety of other corn products including corn gluten feeds and meals. In addition, there are products such as citrus pulp, beet pulp, and whole cottonseed. All these make excellent feeds, but have the disadvantage that their nutrient content is often variable; these feeds should be sampled regularly so estimates of nutrient content can be used in formulating diets and also concern about optimal level use.

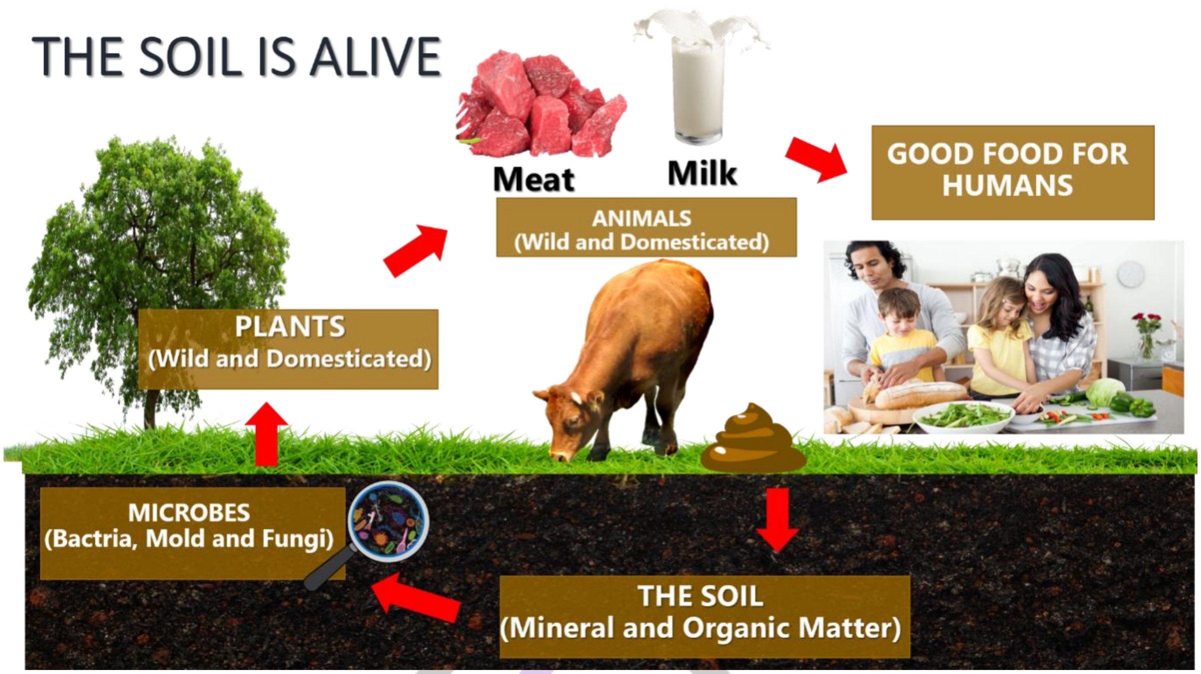

Figure 4. Soil-plant-animals – human cycle.

In conclusion, the soil is alive in term of animal feed by soil play important role for animals feed. Healthy soil provide produced high quality and quantity of feed for animals, animals provide good food in terms of meat and milk for human. So soil is security of feed and food for human.

Reference

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Influence of Nitrogen and Bio regulators Enriched Organics on soil fertility

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***Abstract*: An experiment was conducted at Kuppanur village, Thodamuthur block of Coimbatore district, Tamil Nadu to evaluate the performance of nitrogen and bioregulator enriched poultry manure on soil fertility status. The results showed that the soil nutrient status were significantly influenced by the application of nitrogen and bio regulator enriched poultry manure when compared with control. The manure enriched with nitrogen and bio regulators was found to be superior to poultry manure in recording higher soil available nutrients *viz.*, nitrogen, phosphorus, potassium and sulphur besides improvement in the soil fertility status.**

Keywords*: *Nitrogen, Bio regulator, Poultry manure, Enrichment, Onion and soilfertility

Introduction

Use of bio regulators is one of the safest ways to conserve environmental resources, avoid pollution and improve crop production by maintaining soil health. In this context, investigations were undertaken in three different experiments to evaluate the poultry manure enriched with nitrogen and bio regulators to evaluate the nutrient release pattern of soil to improve the fertility status.

Enrichment of compost / organic wastes with nitrogen fertilizer (Urea) and its blending with biologically active substances (BAS) like, glutathione and methionine is a novel approach to convert composted material into value added manure. One aspect causing uncertainty about the importance of organic N compounds as N source for plants is the possible interaction between organic and inorganic N forms during absorption by plant roots (Thornton and Robinson, 2005). The existing knowledge about these interactions is mainly based on experimental approaches in which plants have been pre-treated with amino acids and subsequently exposed to NO_3^- or NH_4^+ or vice-versa.

The suitability of organic materials as fertilizer depends to a great extent on its rapidity of mineralization and liberation of the nutrients present in them. The mineralization of organic manures in soil is affected by some soil properties like soil type, depth of soil, soil temperature, soil moisture, pH, C/N ratio and lignin content.

Now a day, to meet crop nutrient requirements, application of organic manure is needed. Thus, it is pertinent to observe the changes in soil properties with time due to manuring. Therefore, present study was aimed to study the nutrient release pattern of soil using nitrogen and bio regulators enriched poultry manure.

MATERIALS AND METHODS

A field experiment was conducted during2014-2015 cropping seasons at Kuppanur village, Thondamuthur block of Coimbatore district, Tamil Nadu, India. Experiment was conducted with fifteen treatments comprising of poultry manure@ 5 t/ha, Enriched poultry manure @ 2.5 t/ha with three combinations of amino acids AA_1, AA_2 and AA_3at two doses 2.5 kg/ha and 5.0 kg/ha replicated thrice in Randomised Block Design (RBD).

For preparing nitrogen enriched poultry manure, well decomposed poultry manure was collected from local farm and were dried in air for3 days and sieved through a 2 mm sieve. Processed poultry manure was enriched with nitrogen seven days before application at the ratio of 1:10. In case of bio regulator enriched poultry manure, the required quantity of amino acids were mixed with decomposed poultry manure at the time of application.

The experimental soil was red noncalcareous having pH and EC of 7.52 and 0.50 dSm^{-1} respectively and alkaline $KMnO_4$ - N (345.2 kg/ha), Olsen P (16.8 kg/ha), NN NH_4OAC K (346.2 kg/ha) and available $CaCl_2$ extractable - S (11.2 mg/kg).

A raised bed nursery was prepared and line sowing of onion seeds was taken in the nursery bed and maintained. The nitrogen and bio regulator enriched poultry manure was applied as per the treatment schedule and with regard to chemical fertilizers, 50 % nitrogen as urea, 100% phosphorus as SSP and potassium as MOP was applied as basal.45 days old onion seedlings were transplanted at45 x 10cm distances on the two sides of each ridge and furrow. Remaining 50 % nitrogen was applied at 30 days after transplanting. Plant protection measures were taken up.

The soil and plant sample was collected at different growth stages like vegetative, bulb formation, bulb development and postharvest stage. The collected soil samples were shade dried and sieved through 2 mm sieve and analysed for soil available nutrient status. pH of organic manures and soil was measured by pH meter after preparing the suspension at a ratio of 1:10 and 1:2.5respectively. Electrical conductivity of soil and organic manures was measured in 1:2.5 and 1:10suspensions with the help of conductivity meter. Soil available nitrogen was by the alkaline permanganate method (Subbaiah and Asija, 1956).Available phosphorus was determined by Olsen P method and colour developed in soil extract using the ascorbic acid method. Available potassium was extracted with 1N NH_4OAc buffered at pH 7.0 was read using flame photometer. The sulphate S was extracted by 0.15% $CaCl_2$ solution (Williams and Steinbergs, 1959).

Results and Discussion

Soil available nutrient status Due to the application of enriched poultry manure and bio regulators there is no significant variation in the pH and EC of the soil. Data on thetable.1 indicated the effect of N and bio regulator enriched organics on soil available nutrient status.

The available nutrient status ranged from 330 to343 kg/ha, 11.83 to 15.18 kg/ha, 323 to 342 kg/ha and 9.32 to 10.15 kg/ha of nitrogen, phosphorus, potassium and sulphur respectively. The highest available nitrogen (343 kg/ha), phosphorus (15.18kg/ha), potassium (342 kg/ha) and sulphur status (10.15 mg/kg) were recorded the application of N enriched poultry manure @ 2.5 t/ha along with bioregulator (glutathione, methionine and humic acid) enriched poultry manure @ 5 kg/ha. The lowest available nitrogen status (330 kg/ha) was recorded in control. Amino acids can serve as the sole source of nitrogen which can be taken more rapidly than inorganic N. Application of N and bio regulator (glutathione, methionine andhumic acid) enriched poultry manures improves soil structure which encourages root development which may lead to improvement in the growth of onion crop.

With regard to phosphorus, the highest phosphorus (15.18 kg/ha) status was recorded by the application of N enriched and bio regulator enriched poultry manure. The increase in the soil available phosphorus status might be due to the increased mineralization and solubilization of nutrients in the soil and made available to crop throughout the crop growth period. Whereas the lowest phosphorus (11.83 kg/ha) status was recorded in control.

With regard to available potassium status of soil, the highest potassium status of 342 kg/ha was recorded due to the application of N enriched poultry manure @ 2.5 t/ha along with bio regulator enriched poultry manure @ 5 kg/ha whereas the lowest available potassium status of 323 kg/ha. The increase in potassium status might be due to the application of enriched poultry manure because it contains more of organic potassium that increases the availability of potassium status in soil.

Highest available sulphur of 10.18 mg/kg was recorded in the treatment which received N enriched poultry manure @ 2.5 t/ha along with bioregulator enriched poultry manure @ 5 kg/ha and the lowest available sulphur of 9.32 mg/kg was recorded in the treatment control. The increase in sulphur status might be due to application of N enriched and bio regulator (glutathione, methionine and humic acid)enriched poultry manure because it increased the uptake of nutrients by the plants especially sulphur, the amino acids have a high integrity with different metabolic pools in plants was used to promote plant growth.

Overall, the study revealed that all the treatments involving bio regulator enriched poultry manure addition has recorded significant increase in the soil available nutrients which may, contribute balanced supply of nutrients to the crop for better growth and development.

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Table1: Effect of nitrogen and bio regulators enriched organics on soil nutrient status.

Treatments	Soil nutrient status			
	Nitrogen	**Phosphorus**	**Potassium**	**Sulphur**
T_1-Control	330.03	11.83	323.63	9.32
T_2 – 100% RDN + FYM @ 25 t/ha	330.76	12.04	324.48	9.52
T_3 – 100% RDN + PM @ 5 t/ha	331.60	12.35	325.22	9.42
T_4-100% RDN + PM @ 5 t/ha+ AA_1@ 2.5 kg/ha	332.48	12.56	326.42	9.52
T_5-100% RDN + PM @ 5 t/ha+ AA_1@ 5.0 kg/ha	333.71	12.77	327.25	9.63
T_6-100% RDN + EPM @ 2.5 t/ha+ AA_1@ 2.5 kg/ha	330.67	11.93	324.10	9.32
T_7-100% RDN + EPM @ 2.5 t/ha+ AA_1@ 5.0 kg/ha	331.81	12.46	325.53	9.42
T_8-100% RDN + PM @ 5 t/ha+ AA_2@ 2.5 kg/ha	335.62	12.98	327.89	9.63
T_9-100% RDN + PM @ 5 t/ha+ AA_2@ 5.0 kg/ha	338.07	13.08	329.76	9.73
T_{10}-100% RDN + EPM @ 2.5 t/ha+ AA_2@ 2.5 kg/ha	338.91	13.40	330.01	9.73
T_{11}-100% RDN + EPM @ 2.5 t/ha+ AA_2@ 5.0 kg/ha	341.12	13.61	334.00	9.84
T_{12}-100% RDN + PM @ 5 t/ha+ AA_3@ 2.5 kg/ha	342.08	14.23	336.89	9.84
T_{13}-100% RDN + PM @ 5 t/ha+ AA_3@ 5.0 kg/ha	342.35	14.55	338.13	9.94
T_{14}-100% RDN + EPM @ 2.5 t/ha+ AA_3@ 2.5 kg/ha	342.98	14.86	341.00	9.94
T_{15}-100% RDN + EPM @ 2.5 t/ha+ AA_3@ 5.0 kg/ha	343.25	15.18	342.47	10.15
S.Ed	**0.165**	**0.035**	**0.208**	**0.0081**
C.D(0.05)	**0.338**	**0.096**	**0.426**	**0.0166**

Influence of N and Zn in antioxidant activity of paddy genotypes

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***Abstract*: A rhizobag experiment was initiated to study the potential of uptake of N and Zn by paddy genotypes and to understand the physiological and biochemical mechanisms thereof. Paddy genotypes viz., GGV- 05-01 (V1) and TRY- 3 (V2) were used as test varieties as they were found to be having high and low efficiency respectively in Zinc use among the seven salt tolerant genotypes studied earlier. Maximum catalase activity occurred in the TRY-3 variety under continuous submergence, when Zn @ 50 kg ha^{-1} and N @ 150 kg ha^{-1} were applied and continuous submergence enhanced peroxidase activity to 89.34 U min^{-1} g^{-1} fresh weight, which was significantly higher than saturated soil culture treatment.**

***Keywords*: Rhizobag, Nitrogen, Zinc, Paddy, genotypes, Physiological and biochemical**

Introduction

The world's population is projected to increase from 6 to about 10 billion by 2050, and food production must be increased substantially to keep pace with the food demand of the teeming billions. The cereal production targets have been estimated at about 2500 billion tonnes in 2020 (Frossard et al., 2000). Besides increase in food production, dietary intake of essential elements/nutrients through food is equally important. For example, zinc (Zn) has been identified as one of the micronutrients vital to the enzymatic activities leading to the proper growth and development of plants, animals and human beings (Singh, 2009) and as a possible solution for combating malnutrition (Horton et al., 2009). A major factor causing the widespread occurrence of Zn deficiency (micronutrient malnutrition or hidden hunger) in human beings is the predominant consumption of cereal-based diet with low levels and poor bioavailability of Zn (San, 2006). Zinc deficiency is known to affect skin, gastrointestinal tract, brain, central nervous system, skeletal, reproductive systems and overall immunity.

Being an essential micronutrient, zinc is required for several key plant physiological pathways (Alloway, 2008). Zinc plays a critical role as a structural constituent or regulatory co-factor of a large range of various enzymes and proteins generally associated with carbohydrate metabolism (including photosynthesis and the conversion of sugars into starch), protein metabolism, auxin (growth regulator) metabolism, pollen formation and the resistance to infection by certain pathogens (Alloway, 2008). Among the cereal species, paddy, sorghum and corn are more sensitive to Zn deficiency, whereas barley, wheat and rye are less sensitive (Clark, 1990). It is therefore, imperative to identify and characterize zinc-deficient areas, assess the underlying causes and plan external zinc fertilization. Besides the application of Zn fertilizers for alleviating Zn deficiency in animals and humans, it is also essential to identify Zn-efficient genotypes which are effective in low soil Zn conditions and also in stressed environments such as those existing in saline soils.

Materials and methods

To study the potential of uptake of N and Zn by paddy genotypes and to understand the physiological and biochemical mechanisms thereof. Paddy genotypes viz., GGV- 05-01 (V_1) and TRY- 3 (V_2**)** were used as test varieties as they were found to be having high and low efficiency respectively in Zinc use among the seven salt tolerant genotypes studied earlier. There were totally 36 treatments replicated three times in factorial completely randomized design. 108 plastic pots of 6"× 6"dimensions were used in the study and each pot was filled with approximately 1.2 kg of air-dried soil passed through a 2 mm sieve. A rhizobag technique was used for separating rhizosphere soil. In this technique, a measured weight (600 g) of the processed soil was filled into nylon bags (12 cm×6 cm) with a 400-micron mesh size for restricting entry of roots from outside. These rhizobags were placed in the centre of plastic pots and surrounded by the same soil as was filled inside the bags. Three seedlings of ten days old were transplanted at the centre of each rhizobag. Two moisture regimes *viz.,* continuous submergence (M1) and saturation practices (M2) were followed with three different levels of zinc (0, 37.5 and 50 kg ha^{-1}) and three different levels of nitrogen (0, 125 and 150 kg ha^{-1}) till the period of panicle initiation. Thereafter, plants were harvested and root studies and enzyme studies were carried out at laboratory by using standard procedures. The soil was clayey with pH 8.3, electrical conductivity (EC) 6.0 dS m^{-1}, organic carbon 0.38%, available N 225 kg ha^{-1}, available P 15.8 kg ha^{-1}, available K 374 kg ha^{-1} and available Zn 0.46 mg kg^{-1}. The activity of catalase was determined according to the method of Aebi (1983). The rate of decomposition of H_2O_2 was followed by decrease in absorbance at 240 nm in a reaction mixture containing 1.5 ml phosphate buffer, 1.2 ml of hydrogen peroxide and 300 µl of enzyme extract. The activity of peroxidase was determined according to the method of Rao et al. (1996). 3mL of the reaction mixture contained 100 mM potassium phosphate buffer, pH 6.5, 16 mM guaiacol, 10 µl of 10% H_2O_2 and enzyme extract equivalent to 10 µg protein from leaf and 1.5 µg protein from root tissue. The increase in absorbance at 470 nm (extinction coefficient 26.6 mM^{-1} cm^{-1}) was measured for 5 min.

Results

A rhizobag experiment was conducted by using two paddy varieties (GGV 05-01 and TRY- 3) having low and high zinc yield efficiency index values to assess the difference in physiological and biochemical mechanisms under continuous flooding and saturated soil culture moisture regimes and nutrient (Zn and N) applications.

Antioxidant enzyme activity

Variation in activities of antioxidant enzymes *viz*., catalase, peroxidase, superoxidase dismutase and ascorbate peroxidase due to different moisture regimes, paddy varieties and nutrient management practices are given in Tables 39 and 40.

Catalase

Continuous flooding (M_1) with GGV-05-01 (M_1V_1) registered the highest catalase activity (15.37 U min^{-1} g^{-1} fresh weight), whereas the lowest activity was recorded under M_2V_1 (12.99 U min^{-1} g^{-1} fresh weight), as can be seen in Table 39. Application of Zn @ 50 kg ha^{-1} and N@ 100 kg ha^{-1} recorded maximum catalase activity of 23.8 U min^{-1} g^{-1} fresh weight, which was significantly different from other nutrient combinations. Minimum catalase activity was registered in treatment without zinc and nitrogen application (N_1). The pooled mean data showed that continuous flooding (M_1) maximized catalase activity, and therefore was superior to saturated soil culture. Furthermore, maximum catalase activity occurred in the TRY-3 variety under continuous flooding, when Zn @ 50 kg ha^{-1} and N @ 150 kg ha^{-1} were applied. It was comparable with $M_1V_1N_9$ (28.4 U min^{-1} g^{-1} fresh weight). However, $M_1V_1N_1$, $M_1V_2N_1$, $M_2V_1N_1$ and $M_2V_2N_1$ recorded lower values for catalase activity. Interaction effects among the three factors were found to be significant.

Peroxidase

Maximum peroxidase activity of 94.1 U min^{-1} g^{-1} fresh weight was found under saturated soil culture condition with paddy variety TRY-3 (M_2V_2) and it was significantly different from other treatments. Application of Zn @ 50 kg ha^{-1} and N @ 150 kg ha^{-1} registered a maximum peroxidase activity of 190.6 U min^{-1} g^{-1} fresh weight, whereas no zinc and nitrogen application (N_1) minimized peroxidase activity (50.1 U min^{-1} g^{-1} fresh weight). Continuous flooding (M_1) enhanced peroxidase activity to 89.34 U min^{-1} g^{-1} fresh weight, which was significantly higher than saturated soil culture (M_2) treatment.
A higher peroxidase activity of 257.1 U min^{-1} g^{-1} fresh weight was observed under $M_2V_2N_9$ whereas, the lowest peroxidase activity of 48.9 U min^{-1} g^{-1} fresh weight occurred under $M_2V_1N_1$. However, the latter was comparable with $M_1V_1N_1$, $M_1V_2N_2$, $M_2V_1N_1$, $M_2V_1N_2$, $M_2V_1N_3$, $M_2V_2N_1$ and $M_2V_2N_2$. Interaction effects among the three factors were found to be significant.

Discussion

Antioxidant enzymes viz., catalase, peroxidase, were significantly influenced by various moisture regimes, different levels zinc and nitrogen applications and paddy varieties during the investigation. Application of zinc and nitrogen markedly influenced antioxidant enzyme activity across both moisture regimes and paddy varieties. This could be attributed to the stabilizing and protecting effect of zinc on bio membrane against oxidative and per oxidative damage, and loss of plasma membrane integrity, as well as membrane permeability alteration (Bettger and O'Dell, 1981). Zn may have a role in modulating free radicals and their related damaging effects by enhancing plants' antioxidant systems (Zago and Oteiza, 2001).

Zinc is able to facilitate the biosynthesis of antioxidant enzymes (Cakmak, 2000)**.** Similar results are reported by Rengel, 1995 who stated that upon supply of zinc to deficient plants, zinc inefficient genotypes showed moderate increase in carbonic anhydrase (CA) activity, while zinc-efficient genotypes showed a marked increase in the CA activity, indicating a positive relationship between CA activity and zinc efficiency.

Conclusion

The study reveals that the maximum catalase activity occurred in the TRY-3 variety under continuous submergence, when Zn @ 50 kg ha^{-1} and N @ 150 kg ha^{-1} were applied and continuous submergence enhanced peroxidase activity to 89.34 U min^{-1} g^{-1} fresh weight, which was significantly higher than saturated soil culture treatment.

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Table 1.influence of water regimes and nutrient(Zn and N) levels on antioxidant in paddy leaves.

Treatment	**Catalase Umin-1g-1 fresh weight**					**Peroxidase Umin-1g-1 fresh weight**				
	Continuous flooding		**Saturated soil culture**			**Continuous flooding**		**Saturated soil culture**		
	GGV-05-01	TRY-3	GGV-05-01	TRY-3	Mean	GGV-05-01	TRY-3	GGV-05-01	TRY-3	Mean
N1	7.0	7.5	7.3	8.3	7.53	50.5	49.4	48.4	51.4	50.05
N2	9.8	7.5	10.1	11.9	9.83	57.3	51.4	51.6	51.4	52.93
N3	10.0	12.2	10.8	12.0	11.25	59.9	57.9	51.6	53.3	55.68
N4	14.3	14.0	12.0	12.0	13.08	64.1	64.3	53.9	54.3	59.15
N5	15.5	14.7	12.5	13.9	14.15	75.8	64.4	58.7	61.4	65.08
N6	17.5	15.0	13.0	14.3	14.95	85.9	64.4	64.4	91.8	76.63
N7	17.6	15.4	15.0	17.5	16.38	116.6	105.9	66.2	106.6	98.83
N8	18.2	17.5	18.0	18.0	17.93	122.2	124.4	87.1	120.0	113.43
N9	28.4	28.6	18.2	20.0	23.80	209.8	184.1	111.4	257.1	190.6
MEAN	15.37	14.71	12.99	14.21		93.57	85.13	65.98	94.14	
M	SED	0.07	CD	0.14		M	SED	0.47	CD	0.94
V	SED	0.07	CD	0.14		V	SED	0.47	CD	0.94
N	SED	0.15	CD	0.31		N	SED	1.03	CD	1.99
MV	SED	0.10	CD	0.20		MV	SED	0.66	CD	1.33
MVN	SED	0.31	CD	0.62		MVN	SED	2.00	CD	3.99

Effect of Phosphorus and Sulphur on Available and Uptake of Nutrients in Brinjal

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***Abstract*: Study on the influence of phosphorus and sulphur on soil properties, yield and quality of brinjal (cv. Annamalai). The experiment comprised of four levels of P viz. 0, 30, 60 and 90 kg P_2O_5 ha^{-1} and three levels of S viz. 0, 15 and 30 kg S ha^{-1}. Recommended dose of fertilizer viz., 100 kg N ha^{-1}, 50 kg K ha^{-1} and FYM @ 25 t ha^{-1} were applied uniformly to all treatments. The results of the field experiment clearly revealed that among the different treatments, application of 60 kg P_2O_5 ha^{-1} along with 30 kg S ha^{-1} was superior to the other treatments with regard to available and uptake of N, P, K, S nutrients in brinjal. This was comparable with application of P90S30.**

***Keywords*: Phosphorus, sulphur, available nutrients, uptake of nutrients and brinjal**

INTRODUCTION

Brinjal cultivation in India is estimated to cover about 8.14% vegetable area with a contribution of 9% to total vegetable production. The crop is largely grown in small plots or as inter crop both for cash and domestic consumption by farmers all over India. In India, the area under cultivation of brinjal during 2013-2014 is 711.3 bt ha^{-1} with a production of (13557.8 mt) and the productivity is 19.1 mt ha^{-1} (National Horticulture Board, 2013). The major brinjal producing states are West Bengal, Orissa, Bihar, Gujarat, Maharashtra, Karnataka, Uttar Pradesh, Tamilnadu and Andhra Pradesh. It is a versatile crop adapted to different agro-climatic regions and can be grown throughout the year. It is a perennial, but grown commercially as an annual crop. Fertilizers supply one or more essential plant nutrients which are essential for growth, yield and quality of crops. Increased cropping intensity with minimal and imbalanced use of fertilizers, lead to serious depletion of nutrient reserve in India soils. Fertilizers play a significant role in obtaining higher crop productivity. Generally, solanaceous vegetables require large quantities of major nutrients like N, P and K, in addition to secondary nutrients such as Ca and S for better growth, fruit and seed yield. Among the plant nutrients P and S have a great influence on the yield and quality of brinjal. To fix a large amount of nitrogen in N-deficient soils, an adequate supply of P and S must be assured (Parihar and Tripathi, 2003). Phosphorus is one of the important macronutrients required by plants and is involved virtually in all major metabolic process in plant growth and development. It is an essential part of sugar phosphates involved in photosynthesis, respiration and other metabolic processes like breakdown of sugar and nutrient transport within the plant (Armstrong, 1988). It plays an essential role in energy metabolism, because of its presence in ATP, ADP, AMP and pyrophosphate (Salisbury and Ross, 1992). Sulphur was a neglected plant nutrient, since it was being added to soil incidentally through sulphur containing major fertilizers, till the recent past. Sulphur nutrition has been receiving increasing attention worldwide during the past few years and reports of sulphur deficiency and crop responses to sulphur application are increasing, as it plays an important role in protein formation. Sulphur also improves yield and quality parameters of important vegetable crops. It is a constituent of secondary compounds *viz*., allin, cycloallin and thiopropanol which not only influence the taste, pungency and medicinal properties of vegetable crops but also induce resistance against pests and diseases (Tabatabai, 2001). Imbalanced application of P and S as fertilizers increases production cost and hampers the morphological characters of brinjal. As a result, a positive interaction is required between P and S for better yield and quality of brinjal. Considering this point, an experiment was conducted by combining different levels of P and S along with other recommended dose fertilizers with an aim to evaluate the effect of P and S on soil properties, yield and quality of brinjal.

MATERIALS AND METHODS

A field experiment was conducted in farmer's field at Sivapuri village, near Chidambaram, Cuddalore District, Tamil Nadu. The treatments were laid out in a Factorial Randomized Block Design (FRBD) with 12 treatments and 3 replications. Seedlings were raised in a nursery bed. There were in total, 36 numbers of plots of 4m × 3m size. Fertilizers at recommended dose were added and thoroughly mixed with the soil. Phosphorus and sulphur as DAP and gypsum, respectively, were applied as per the treatments fixed in the experiment. Recommended dose of fertilizer viz., N @ 100 kg ha^{-1} and K @ 50 kg ha^{-1} along with FYM @ 25 t ha^{-1} were applied uniformly all the treatment plots. Full amount of K @ 50 kg ha^{-1} and one-half of N @ 50 kg ha^{-1} were applied during final plot preparation in the form of Muriate of potash and urea, respectively. Another half of the N @ 50 kg ha^{-1} dose was applied 45 days after transplanting. Healthy and uniform sized 40 day old seedlings were uprooted carefully from the seed bed so as to minimize damage to the roots. Sixteen seedlings were transplanted in each plot. Irrigation was given immediately after transplanting. A composite soil sample for initial analysis was collected from the proposed experimental field before sowing. It was air dried in shade, powdered and sieved to pass through 2 mm sieve, thoroughly mixed and used for detailed analysis. The plant samples were collected at 30 DAT, 60 DAT and 90 DAT. The plant samples were then shade dried and kept in a hot air oven for 72 hours at 40^{o}C. After weighing, the plant samples were powdered in a Wiley mill with 1 mm sieve and analyzed for N, P, K and S contents. Fruits were harvested from 75 DAT up to 150 DAT. The crude protein and ascorbic acid content were estimated in the brinjal fruits.

RESULT AND DISCUSSION

Uptake nutrients by plant																
	N uptake (kg ha^{-1})				P uptake (kg ha^{-1})				K uptake (kg ha^{-1})				S uptake (kg ha^{-1})			
Treatment	30 DAT	60 DAT	90 DAT	FU	30 DAT	60 DAT	90 DAT	FU	30 DAT	60 DAT	90 DAT	FU	30 DAT	60 DAT	90 DAT	FU
$P_0 S_0$	15.18	30.35	45.02	53.12	6.58	10.24	12.06	10.12	29.80	37.42	43.64	48.63	3.96	6.84	7.32	6.20
$P_0 S_{15}$	16.84	31.74	46.64	56.52	6.58	12.98	14.94	10.20	32.14	39.26	45.86	49.22	4.68	7.36	8.14	7.12
$P_0 S_{30}$	18.92	33.18	48.86	59.07	6.58	15.56	17.20	10.73	35.68	41.54	48.82	51.38	6.10	8.10	9.96	8.93
$P_{30} S_0$	17.84	31.96	47.20	62.96	9.14	13.14	15.02	15.20	33.48	40.02	46.24	53.22	4.02	6.96	7.95	6.85
$P_{30} S_{15}$	19.72	34.60	49.88	65.23	12.14	16.20	18.12	15.77	38.16	43.45	49.10	57.56	4.94	7.68	8.88	7.97
$P_{30} S_{30}$	21.96	36.27	51.52	70.80	14.68	18.38	20.64	16.83	40.36	45.22	52.24	60.00	6.34	8.74	10.28	9.33
$P_{60} S_0$	19.88	35.22	50.08	73.30	14.68	16.88	19.00	18.66	38.76	44.10	50.60	69.73	4.38	7.02	8.20	7.00
$P_{60} S_{15}$	22.04	37.93	51.86	75.85	15.02	18.98	21.58	19.03	42.84	47.16	53.62	71.84	5.06	7.98	9.10	8.09
$P_{60} S_{30}$	23.98	40.72	53.76	79.03	17.10	20.46	23.96	19.95	46.74	50.34	56.72	74.34	6.58	9.04	10.44	9.91
$P_{90} S_0$	20.06	35.78	50.44	74.41	13.64	17.12	19.72	19.00	39.20	44.94	51.36	70.03	4.46	7.06	8.21	7.22
$P_{90} S_{15}$	22.90	38.96	52.08	76.14	15.58	19.10	22.26	19.84	43.18	48.04	54.18	72.24	5.10	8.02	9.12	8.54
$P_{90} S_{30}$	24.14	40.98	54.10	80.38	17.60	20.64	24.24	20.15	47.34	51.36	57.08	74.69	6.60	9.08	10.68	9.95
SED	0.47	0.57	0.65	1.59	0.60	0.62	0.78	0.44	0.96	1.40	1.10	1.21	0.07	0.06	0.14	0.19
CD	0.96	1.12	1.28	3.31	1.18	1.24	1.56	0.91	1.86	2.90	2.18	2.52	0.14	0.12	0.28	0.41

Soil Nutrient availability

Available N in soil

The data on available of N revealed that application of 60 kg P_2O_5 ha^{-1} recorded significantly higher available N (235.51 kg ha^{-1}) in soil over other treatments. The lowest available of N was noticed in control (224.71 kg ha^{-1}) in soil. A numerical increase in the available N in soil was registered with 90 kg P_2O_5 ha^{-1} but it was found to be insignificant. This may be ascribed to the role of phosphorus, constituent of ribonucleic acid, deoxyribonucleic acid and ATP, which regulates the vital metabolic process in the plant, helping in root formation and nitrogen fixation. Significant differences with respect to available N were observed due to application of different levels of S. Treatment S_{30} recorded significantly higher available N (238.12 kg ha^{-1}) compared to other treatments in soil.

Available N in soil increased up to 60 DAT and thereafter decreased with advancement in crop growth. The reason for increase the available N at 60 DAT might be due to the application of second half dose of urea. Thereafter, a decreasing trend in the available N in soil was observed. Crop utilization and other loss mechanisms operating in the system would have favoured this decrease with advancement in growth (Periyaiah, 1986; Angayarkanni, 1989).

Available P in soil

The data on soil available P revealed that application of 60 kg P_2O_5 ha^{-1} recorded significantly higher available P (25.08 kg ha^{-1}) in soil over other treatments. The lowest available P was noticed in control (15.77 kg ha^{-1}) in soil. A numerical increase in the available P in soil was registered with 90 kg P_2O_5 ha^{-1} but it was found to be statistically insignificant. This may be attributed to better proliferation of healthy lateral and fibrous roots due to P availability. (Parthar and Tripathi, 2003) Liberation of strong acids from applied sulphur and its consequent dissolution effect, might be one of the reasons for increased availability of P in soils (Upadhyay *et al*., 1999). Significant differences with respect to available P were observed due to application of different levels of S. Treatment S_{30} recorded significantly higher available P (22.73 kg ha^{-1}) compared to other treatments in soil. The synergistic relationship between sulphur and phosphorus would have caused an increase in the available P in soil. **Available K in soil**

Availability of K in soil was influenced by different levels of phosphorus. Application of 60 kg P_2O_5 ha^{-1} (315.06 kg ha^{-1}) recorded the highest available K. The lowest available K was recorded with the control treatment (284.09 kg ha^{-1}) at all stages of growth. A numerical increase in the available K in soil was registered with 90 kg P_2O_5 ha^{-1} but it was found to be statistically insignificant. Significant differences with respect to availability of soil K were observed due to application of different levels of S. Treatment S_{30} recorded significantly higher available K (315.13 kg ha^{-1}) compared to other treatments. The lowest available of K was obtained in control (293.31 kg ha^{-1}). Application of sulphur might have had a marked influence on the dissolution of potassium in soils making it available for growth of plants. A reduction in soil potassium was recorded with growth of brinjal plants. This might be due to better crop growth as reflected by higher biomass, leading to greater uptake of nutrients by the crop resulting in the reduction of soil available K status of the soil. Similar findings were reported by Suthakar (2000) and Manu (2001).

Available S in soil

Available S in soil was influenced by different levels of phosphorus, Application of 60 kg P_2O_5 ha^{-1} (12.23 kg ha^{-1}) recorded the highest available S in soil. The control treatment recorded the lowest soil available S (11.10 kg ha^{-1}) at all stages of growth. A numerical increase in the available S in soil was registered with 90 kg P_2O_5 ha^{-1} but it was found to be insignificant. Significant differences with respect to available S were observed due to application of different levels of S. Treatment S_{30} recorded significantly higher available S in soil (15.39 kg ha^{-1}) compared to other treatments. The lowest available S was obtained in control (8.12 kg ha^{-1}). This might be attributed to the increased availability of sulphur with increasing levels of sulphur application. Increased uptake of sulphur by all treatments might have also contributed to a difference in the resultant soil available sulphur. Increased sulphur doses might have also helped in uniform distribution of available sulphur within the soil rhizophere.

Effect of on plant nutrient uptake

N uptake

Different levels of P significantly influenced the uptake of N by brinjal plant and fruits. Among different levels of P, P_{60} recorded significantly higher uptake of N (16.71 kg ha^{-1}) compared to other treatments and control (21.67 kg ha^{-1}). Though there was a numerical increase in the N uptake in plant with 90 kg P_2O_5 ha^{-1}, it was found to be insignificant. A similar trend was recorded with reference to brinjal fruits also. Hasan *et al*., (2013) reported that the concentration of N in brinjal was significantly influenced by the application of different levels of P. This result was also similar to the result of Dass and Mishra (2002) that application of P @ 60 kg ha^{-1} produced maximum N uptake by chilli. This may be due to higher dry matter accumulation and translocation of photosynthates from vegetative parts to pod as a result of N uptake at higher doses of phosphorus. Sulphur fertilization also recorded a significant response on N uptake. The highest N uptake was recorded with the application of 30 kg S ha^{-1} (21.53 kg N ha^{-1}). This might have occurred due to the synergistic effect of sulphur on nitrogen. Sivakumaran (2005) also reported that S application significantly influenced the uptake of N. This may be attributed to the effect of sulphur which promotes vigorous root and shoot growth resulting in higher absorption of nitrogen from the soil. This is further supported by the fact that sulphur deficiency prevents utilization of nitrogen and also brings about an accumulation of soluble nitrogen within the plants. Jat and Mehra (2007) also reported that application of S 60 kg ha^{-1} increase the N uptake. Uptake of N was significantly influenced by combined influence of phosphorus and sulphur. Combined application of P_{60} S_{30} recorded the highest N uptake (23.10 kg N ha^{-1}). Level $P_{60}S_{30}$ was found to be statistically on par with P_{90} S_{30}. This might be due to the fact that, nutrients such as nitrogen applied in smaller amounts as DAP, through soil application, would have been easily absorbed and translocated in plants without any loss. Similar results were reported by Hasan *et al.* (2013) in brinjal crop. This may also be due to the effect of S in solubilizing the native phosphorus resulting in an increased uptake of N by plants.

P uptake

The data on uptake of P revealed that the application of 60 kg P_2O_5 ha^{-1} recorded significantly higher P uptake (15.06 kg P_2O_5 ha^{-1}) by brinjal plant over other treatments. Though there was a numerical increase in the P uptake in plant with 90 kg P_2O_5 ha^{-1}, it was found to be insignificant. A similar trend was recorded with regard to uptake of P by brinjal fruits also. This might be due to higher availability of P to the crop. This may be due to the higher availability of phosphorus, leading to higher uptake by the brinjal plant. Significant differences with respect to uptake of P were observed due to application of different levels of S. Treatment S_{30} recorded significantly the higher uptake of P (15.10 kg P_2O_5 ha^{-1}) compared to other treatments. This result may be attributed due to synergistic effect of S on P. Suresh (2008) also reported similar result in lady's finger. Application of sulphur not only acted as a source of sulphur but it also influenced the physical, chemical and biological properties of soil resulting in higher nutrient uptake Kashirad and Bazargani (1991). Release of nutrients in available form and other physical properties might have influenced the availability of other nutrients leading to their absorption, thereby showing a higher content with application of sulphur. The increase in the uptake of P due to incorporation of S might be owing to the mobilization of soil into available form for plant use. Increases in uptake of nutrients with sulphur application at varying levels have been reported by Sharma (1991) and Mina (2000). Uptake of P was significantly influenced by combined influence of phosphorus and sulphur. The highest P uptake (17.10 kg P_2O_5 ha^{-1}) was recorded with $P_{60}S_{30}$. This result may be due to the synergistic relationship of the between P and S resulting in a favourable influence on phosphorus availability leading to a positive impact on the growth character as well as on the phosphorus content of plant. Similar results were reported by Thakre *et al.,* (2005) in brinjal.

K uptake

Significant differences in the uptake of K were obtained due to various P levels. The highest K uptake (42.78 kg K ha^{-1}) was recorded with 60 kg P_2O_5 ha^{-1}, and the lowest K uptake (32.54 kg K ha^{-1}) was recorded from control. A numerical increase in the K uptake in plant with 90 kg P_2O_5 ha^{-1} was registered, but it was found to be insignificant. Similar results were registered with brinjal fruits also. This result may be attributed to the synergistic effect of P aver K, which enhanced the uptake of K by the crop. Similar observations were made by Hasan *et al.,* (2013) who reported that application of P @ 60 kg ha^{-1} increased the K uptake in brinjal. Sulphur fertilization also had a significant response on K uptake. The highest K uptake was recorded at S_{30} (42.53 kg K ha^{-1}). Gangadhar (2004) reported that different levels of S influenced the uptake of K in lentil. This may be due to the positive influence of sulphur fertilization on potassium availability by way of improved nutritional environment in the rhizosphere resulting in increased availability of K in the root zone coupled with increased K uptake. Similar findings were reported by Jat and mehra (2007).

S uptake

S uptake in plant was influenced by different levels of phosphorus in brinjal. Application of 60 kg P_2O_5 ha^{-1} (5.34 kg S ha^{-1}) recorded the highest S uptake and lowest S uptake was recorded in control (4.91 kg S ha^{-1}) at all the growth stages of brinjal. This was reflected on the S uptake by brinjal fruits. Higher levels of P, was however found to be statistically insignificant. Moderate levels of phosphorus application (30 and 60 kg P_2O_5 ha^{-1}) appeared to have induced better root development and showed beneficial effect on S uptake (Singh et al. 1986). Sinha *et al* (1995) reported that at higher levels of P (120 kg P_2O_5 ha^{-1}), uptake of S decreased which might be due to the depressive effect of P on S. Significant differences with respect to uptake of S were observed due to application of different levels of S. Treatment S_{30} recorded significantly higher uptake of S (6.40 kg S ha^{-1}) compared to other treatments. The lowest uptake of S was obtained in control (4.21 kg S ha^{-1}). This might be due to higher availability of S from the soil and its subsequent translocation into the plant. Suresh (2008) also reported similar result in lady's finger. Thakre et al., (2005) also reported that increasing levels of S significantly increased S content in brinjal and maximum content was recorded with application of 40 kg S ha^{-1}. Sinha *et al.,* (1995) reported that increase in S uptake with increasing levels of S seems to be associated with increased S availability from applied S with a concomitant increase in crop yield. Sulphate is not as strongly bound (fixed) to soil particles as phosphate and is thus more available to plant roots leading to higher uptake.

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EFFECT OF DRIP IRRIGATION REGIMES AND FERTIGATION LEVELS ON SOIL AND LEAF NUTRIENT STATUS OF MANGO UNDER ULTRA HIGH DENSITY PLANTING

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***Abstract*: An experiment was conducted with an objective of assessing effect of drip irrigation regimes and fertigation levels on soil and leaf nutrient status of mango cv. Alphonso under ultra-high density planting. There were three irrigation regimes in main plots namely I_1 (16 litres per day per plant; lpdp), I_2 (20 lpdp) and I_3 (24 lpdp) and four fertigation levels in subplots *viz*., F_1 (50% recommended dose of fertilizer; RDF), F_2 (75 % RDF), F_3 (100 % RDF) and F_4 (125 % RDF) replicated three times in a split plot design. The results revealed that among the irrigation treatments I_3 - 24 lpdp recorded the highest leaf N, P and K status and highest soil NPK status was recorded by I_2 - 20 lpdp. On comparison of sub plot treatments, the highest soil ans leaf NPK content was recorded by application of 125% RDF (F4) through fertigation. In the interaction effect, leaf NPK content was highest by I_3F_3 and soil NPK was maximum by I_2F_3. of mango var. Alphonso under ultra high density planting.**

***Keywords*: Irrigation, Fertigation, soil, leaf, NPK**

Introduction

Although India is the largest producer of mango, its productivity is only 5.5 MT tonnes /ha as against 30 tonnes/ha in Israel. Small size orchards, low yielding traditional varieties, poor orchard management like existence of wider spacing, poor or nil nutrient and canopy management practices and inadequate technological up gradation are the major constrains for lower productivity of mango orchards. Among the various factors listed above, poor water and nutrient management is an important factor, which has totally been ignored or neglected in mango, despite the fact that scientific recommendations are available in our country than at regional level (Anon., 2004). Since it is a perennial crop, attention towards meeting its water and nutritional requirements is of paramount importance. Optimum vegetative growth, better yields, competent fruit quality and greater storage life of fruits depend upon proper irrigation and nutrition to the trees. The water requirement for mango is not systematically studied in the recent time which is taken as the first objective of the present experiment. The right combination of water and nutrients is the key for high yield and quality of produce. Recently, fertigation, the most efficient method of fertilizer application, which ensures application of fertilizers directly to plant roots (Patel and Rajput, 2001) is gaining popularity in all fruit crops including mango. As reiterated earlier, another reason for low productivity is wider spacing and poor land utilization. To alleviate this, adopting high density planting has been recommended (Balasubramanyan *et al.*, 2009). Of late, the high density planting systems are becoming popular in mango, people adopting different spacing namely 5m × 5m, 10m × 5 m etc., according to their own wishes. Under such system, when more population per hectare is being planted, the demand for water and nutrients may be also varying as compared to conventional systems. One step further in this direction is the use of Ultra High Density Planting (UHDP) System with a spacing of 3m × 2m, to explore the maximum utilization of land. With this background, an experiment was undertaken to study the effect of irrigation regimes and fertigation levels on soil and leaf nutrient status mango var. Alphonso under Ultra-High Density planting.

Materials and Methods

A field experiment was conducted at JISL Farm, Elayamuthur, Udumalpet, in Mango var. Alphonso by Department of Fruit Crops, Horticultural College and Research Institute, TNAU, Coimbatore to study the water and nutrient requirement of mango variety Alphonso under Ultra High Density Planting (3m × 2m). There were three irrigation regimes in main plots namely I_1 (16 lpdp), I_2 (20 lpdp) and I_3 (24 lpdp) and four fertigation levels in subplots viz., F_1 (50 per cent RDF), F_2 (75 per cent RDF), F_3 (100 per cent RDF *i.e*. 120:75:100) and F_4 (125 percent RDF) replicated three times in a split plot design. In main plots, irrigation treatments were given on daily basis and in sub plots, fertigation treatments were given at weekly interval. Thus, there were twelve treatment combinations with irrigation and fertigation. Irrigation regimes were applied through drip irrigation system as per treatment schedule at daily interval excluding December month to induce stress for flowering.

Results and Discussions

In the present investigation, the N, P and K contents in leaves at pre-flowering, flowering, fruit development and harvest stages were estimated. The application of 125 and 100 per cent RDF through fertigation expressed better nutrient content of leaves at flowering, fruit development and at harvest stages (Table 1). Increased nutrient status at different stages of crop growth may be due to accumulation of carbohydrate, which may take place gradually with the advancement of crop growth. Nutrient content plays a prime role in higher yield and quality of fruits in mango. Nitrogen is an important constituent of amino acids, proteins, enzymes, nucleic acids and chlorophyll content. In the present investigation, application of 125 and 100 per cent RDF through fertigation system led to higher nitrogen content in leaves, at all the stages studied. The nitrogen content was higher in leaves at flowering stage and thereafter, the N content was found to decline towards maturity. This might be due to increased nutrient uptake by the developing sink *i.e*. fruits Sivakumar (2007). Similar findings were also reported by Umaheswarappa *et al*. (2005).

Phosphorus plays a key role in energy transfer system of plants. In the present study, application of 125 and 100 % RDF through fertigation showed increased leaf P content compared to lower level of P applied and it exhibits differential pattern from pre flowering stage to fruit development stage (Table 2). This could be attributed to higher level of P applied through fertigation and higher nutrient efficiency. Moreover, application of higher level of P might have helped in the root proliferation, leading to the formation of number of feeder roots and better uptake of available nutrients resulted in higher content of P in leaves.

Potassium (K), being a protoplasmic factor, is an essential plant nutrient. Many enzymes are activated by K and it is also involved in photo oxidative phosphorylation, thus augmenting the energy required for fruit growth. The K content was higher in leaves at fruit development stage and thereafter, the K content was found to decline towards maturity (Table 3). Application of 125 and 100 per cent RDF through fertigation registered the highest K content in leaf. It is also possible that the fertigation with 100 per cent RDF might have activated the physiological processes for the rapid absorption and utilization of nutrients for the primary metabolic processes. Similar findings were reported by Ghanta and Mitra (1993) and Singh *et al.* (1995).

Plant nutrient availability in the soil is very important for exploiting higher production. The nutrients, applied at any stage, should proportionately reflect in terms of available nutrient in soil so that the plants could absorb these nutrients efficiently without any hindrance. Leaching, volatilization and fixation of nutrients in soil are some of the factors that affect the availability of soil nutrients. In the present investigation, the variations in nutrient availability due to different levels of irrigation and fertigation were estimated at different stages of crop growth. The analysis revealed that application of 20 litres per day per plant recorded the highest available NPK in soil (Table 4).

It was also revealed that application of 125 and 100 per cent RDF through fertigation recorded the highest available NPK in soil, supporting the concept of higher levels of fertilizers resulting in enhanced growth and yield (Table 5&6). The mobility of nutrients was well pronounced under drip fertigation system. Nutrients were carried along with the water movement and concentrated near the outer periphery of the wetting zone. Similar report was given by Sureshkumar (2000).

Conclusion

From the results, it could be concluded that drip irrigation method of irrigation and fertilization is a better management practice in mango for higher growth and yield. Water applied through drip irrigation at 24 litres/day/plant is optimum for maintaining plant vigour in mango var. Alphonso. Moreover, higher level of fertilizer that is 125% RDF and 100% RDF applied through drip irrigation increase soil, leaf NPK, enhanced the nutrient uptake, increased the nutrient efficiency ultimately resulting in higher plant growth and yield.

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Table 1. Effect of irrigation regimes and fertigation levels on leaf nitrogen content (%) at various stages

I / F	Pre flowering stage				Flowering to fruit set				Fruit development stage			
	I_1	I_2	I_3	**Mean**	I_1	I_2	I_3	**Mean**	I_1	I_2	I_3	**Mean**
F_1	0.87	1.27	1.15	**1.09**	1.33	1.43	1.61	**1.46**	1.22	1.22	1.51	**1.32**
F_2	0.90	1.09	1.23	**1.08**	1.41	1.57	1.73	**1.57**	1.31	1.46	1.62	**1.46**
F_3	0.95	1.20	1.30	**1.15**	1.40	1.64	1.75	**1.60**	1.36	1.53	1.64	**1.51**
F_4	0.99	1.26	1.11	**1.12**	1.49	1.73	1.74	**1.65**	1.38	1.65	1.63	**1.56**
Mean	**0.93**	**1.20**	**1.19**		**1.41**	**1.60**	**1.71**		**1.32**	**1.47**	**1.60**	
	I	**F**	**I X F**		**I**	**F**	**I X F**		**I**	**F**	**I X F**	
SEd	0.067	0.079	0.136		0.013	0.016	0.028		0.001	0.001	0.002	
CD (0.05)	0.187	NS	NS		0.037	0.034	0.062		0.001	0.002	0.003	

Table 2. Effect of irrigation regimes and fertigation levels on leaf phosphorus content (%) at various stages

I / F	Pre flowering stage				Flowering to fruit set				Fruit development stage			
	I_1	I_2	I_3	**Mean**	I_1	I_2	I_3	**Mean**	I_1	I_2	I_3	**Mean**
F_1	0.09	0.11	0.15	**0.12**	0.13	0.14	0.19	**0.15**	0.11	0.12	0.16	**0.13**
F_2	0.10	0.13	0.16	**0.13**	0.13	0.18	0.21	**0.17**	0.12	0.14	0.17	**0.14**
F_3	0.12	0.15	0.19	**0.15**	0.15	0.18	0.24	**0.19**	0.13	0.16	0.20	**0.16**
F_4	0.12	0.17	0.18	**0.16**	0.15	0.20	0.23	**0.20**	0.13	0.18	0.19	**0.17**
Mean	**0.11**	**0.14**	**0.17**		**0.15**	**0.17**	**0.22**		**0.12**	**0.15**	**0.18**	
	I	**F**	**I X F**		**I**	**F**	**I X F**		**I**	**F**	**I X F**	
SEd	0.001	0.001	0.001		0.011	0.003	0.012		0.001	0.001	0.002	
CD (0.05)	0.002	0.002	0.003		0.029	0.007	0.031		0.002	0.003	0.004	

Table 3. Effect of irrigation regimes and fertigation levels on leaf potassium content (%) at various stages

I / F	Pre flowering stage				Flowering to fruit set				Fruit development stage			
	I_1	I_2	I_3	**Mean**	I_1	I_2	I_3	**Mean**	I_1	I_2	I_3	**Mean**
F_1	0.32	0.37	0.43	**0.38**	0.48	0.53	0.43	**0.48**	0.49	0.61	0.71	**0.61**
F_2	0.33	0.32	0.44	**0.36**	0.50	0.60	0.44	**0.52**	0.50	0.59	0.70	**0.60**
F_3	0.37	0.44	0.45	**0.42**	0.56	0.63	0.67	**0.62**	0.62	0.68	0.72	**0.68**
F_4	0.34	0.44	0.46	**0.41**	0.58	0.65	0.68	**0.64**	0.59	0.71	0.73	**0.69**
Mean	**0.35**	**0.40**	**0.45**		**0.54**	**0.61**	**0.56**		**0.56**	**0.65**	**0.72**	
	I	**F**	**I X F**		**I**	**F**	**I X F**		**I**	**F**	**I X F**	
SEd	0.006	0.008	0.013		0.001	0.001	0.002		0.004	0.005	0.009	
CD (0.05)	0.017	0.016	0.030		0.003	0.002	0.004		0.011	0.011	0.019	

Table 4. Effect of irrigation regimes and fertigation levels on soil Nitrogen (Kg ha^{-1}) content at various stages.

I / F	Pre flowering stage				Flowering to fruit set				Fruit development stage			
	I_1	I_2	I_3	Mean	I_1	I_2	I_3	Mean	I_1	I_2	I_3	Mean
F_1	264.4	268.5	259.8	**264.2**	241.4	251.1	240.2	**244.2**	174.4	180.2	168.5	**174.4**
F_2	280.0	281.2	273.3	**278.2**	260.4	262.8	254.0	**259.1**	201.8	205.8	201.5	**203.1**
F_3	283.9	289.9	279.8	**284.5**	269.8	272.4	264.5	**268.9**	219.5	222.7	211.1	**217.8**
F_4	305.8	308.2	292.8	**302.3**	289.9	293.2	276.1	**286.4**	229.6	235.0	220.9	**228.5**
Mean	**283.5**	**287.0**	**276.4**		**265.4**	**269.9**	**258.7**		**206.3**	**210.9**	**200.5**	
	I	**F**	**I X F**		**I**	**F**	**I X F**		**I**	**F**	**I X F**	
SEd	0.617	0.611	1.105		0.005	0.006	0.010		0.005	0.005	0.009	
CD (0.05)	1.712	1.284	2.553		0.015	0.012	0.024		0.014	0.010	0.021	

Table 5. Effect of irrigation regimes and fertigation levels on soil Phosphorus (Kg ha^{-1}) content at various stages.

I / F	Pre flowering stage				Flowering to fruit set				Fruit development stage			
	I_1	I_2	I_3	Mean	I_1	I_2	I_3	Mean	I_1	I_2	I_3	Mean
F_1	26.73	26.93	26.41	**26.69**	24.31	24.45	23.37	**24.04**	21.57	22.51	21.30	**21.80**
F_2	26.97	27.39	26.72	**27.02**	27.68	24.92	23.85	**25.48**	21.65	22.69	22.05	**22.13**
F_3	27.71	28.00	27.56	**27.76**	24.94	24.98	24.16	**24.69**	22.70	22.90	22.69	**22.76**
F_4	28.58	28.78	27.92	**28.42**	25.17	25.44	24.78	**25.13**	23.08	23.63	22.84	**23.18**
Mean	**27.50**	**27.77**	**27.15**		**25.52**	**24.94**	**24.04**		**22.25**	**22.93**	**22.22**	
	I	**F**	**I X F**		**I**	**F**	**I X F**		**I**	**F**	**I X F**	
SEd	0.030	0.039	0.066		0.002	0.002	0.003		0.091	0.088	0.160	
CD (0.05)	0.084	0.082	0.148		0.005	0.004	0.007		0.251	0.184	0.370	

Table 6. Effect of irrigation regimes and fertigation levels on soil Potassium (Kg ha^{-1}) content at various stages.

I / F	Pre flowering stage				Flowering to fruit set				Fruit development stage			
	I_1	I_2	I_3	Mean	I_1	I_2	I_3	Mean	I_1	I_2	I_3	Mean
F_1	329.9	356.2	320.3	**335.5**	342.5	364.3	323.7	**343.5**	430.7	480.2	408.0	**439.6**
F_2	337.6	366.9	328.7	**344.4**	356.0	384.2	343.0	**361.1**	462.3	491.3	456.7	**470.1**
F_3	361.9	379.9	350.0	**363.9**	373.9	398.3	370.2	**380.8**	480.9	506.2	480.5	**489.2**
F_4	369.7	388.9	376.6	**378.4**	388.8	402.2	389.8	**393.6**	497.8	513.6	488.8	**500.1**
Mean	**349.8**	**373.0**	**343.9**		**365.3**	**387.3**	**356.7**		**467.9**	**497.8**	**458.5**	
	I	**F**	**I X F**		**I**	**F**	**I X F**		**I**	**F**	**I X F**	
SEd	0.119	0.168	0.279		0.001	0.001	0.001		0.133	0.158	0.272	
CD (0.05)	0.331	0.354	0.621		0.002	0.002	0.003		0.370	0.332	0.615	

ECO-FRIENDLY UTILIZATION OF TREATED DISTILLERY EFFLUENT AND FERTILIZERS ON SOIL PROPERTIES AND SEED CANE YIELD

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***Abstract*: The results of the experiment revealed that among the main plot treatments application of TDE at a dilution 1:10 on 75th, 120th and 165th days after planting (M_4) recorded highest soil chemical properties like available N, P, K, exchangeable cations, micronutrients and yield. On comparison of sub plot treatments, same results were noticed by application 100 per cent RDF (S_2). In the interaction effect, application of three times TDE along with 100 per cent recommended dose of fertilizers (225:62.5:112kg NPK/ ha /year) has resulted in the improvement of soil parameters leading to enhanced seed caneyield.**

***Keywords*: seed cane, TDE, fertilizers, soil characters and cane yield**

INTRODUCTION

In recent years, wastewater reuse has increased significantly worldwide. In India, the abundance of soils with low organic matter content, favours the use of industrial wastewaters containing organic matter as an organic amendment and nutrient supply to soil. Industrial waste is nontoxic, biodegradable, purely of plant origin and contains large quantities of soluble organic matter. Keeping in view the TDE and role of fertilizers in crop production, an experiment was undertaken to assessing the eco-friendly utilization TDE and fertilizers on soil chemical, biological properties and seed cane yield.

Materials and methods

A field experiment was conducted 2012 in the village Karamanikuppam, Cuddalore district, Tamil Nadu by Department of soil science and Agricultural chemistry ADAC&RI, TNAU, Coimbatore and EID Parry (I) ltd, to assess the eco-friendly utilization TDE and fertilizers on soil chemical properties and seed cane yield. There were four main plots viz., M_1 (control), M_2 (TDE at a dilution 1:10 on 75th day after planting), M_3 (TDE at a dilution 1:10 on 75th and 120th day after planting and M_4 (TDE at a dilution 1:10 on 75th, 120th and 165th days after planting) and five different combinations of fertilizer treatments viz., S_1 (control), S_2 (100 per cent NPK), S_3 (100 per cent NP), S_4 (75 per cent N and 100 per cent P) and S_2 (75 per cent NP) were imposed as subplot treatments in a split plot design. Thus, there were twenty treatment combinations with TDE and fertilizers.

Results and discussions

Application of TDE had a favourable influence on the available N,P and K content in soil at each growth stages. The organic form of N supplied by the application of TDE might have been slowly released into the available pool and thereby increased the available N content. The contribution of P from TDE, the HCO_3 of TDE and organic acid produced during decomposition of organic matter might have solubilized the native insoluble soil P and thus helped to increase the available P content of soil. Similar results were obtained by Anandakrishnan *et al.* (2008). Increase in the available K content of the surface soil was sustained even after harvest of sugarcane crop. The application of 100 per cent RDF had high nutrient content in all the three stages of growth. In all the three stages, the highest available N status was recorded in 100 per cent RD of NP and NPK along with three times of diluted TDE might be due to combined nitrogen supply from both the inorganic source and organic source in to the available pool.

Cane yield and yield attributes

The results of the field experiment revealed that the application of different levels of diluted TDE significantly increased the yield of seed cane. An increased cane yield of 16.5, 28.3 and 33.7 per cent were recorded for the application of one time (M_2), two times (M_3) and three times (M_4) diluted TDE respectively over control (M_1). The interaction effect revealed that three times application of diluted TDE together with 75 per cent NP fertilizer (M_4S_5) is the most suitable combination of nutrient management for good seed cane. It is noteworthy that the application of inorganic fertilizers omitting K and 25 per cent N and P, in combination with three times of diluted TDE gave high yield as that of 100 per cent NPK combination leading to a saving of 100 per cent K and 25 per cent NP.The higher response of sugarcane for diluted treated distillery effluent application might be attributed to the enhanced availability of plant nutrients. Further, the solubilising effect of decomposing organics in TDE and the retention of more plant nutrients in the soil for longer period resulting in higher cane yield as reported by Kanwar and Kapur (1987).\

Conclusion

Three times application of TDE at 1:10 dilution on 75, 120 & 165th days after planting along with S_5 (75 per cent NP) has resulted in the improvement of soil chemical properties leading to enhanced yield of sugarcane nursery crop in medium textured soil (sandy loam).

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Kanwar, R. S and K. Kapur.1987.Direct and residual effects of sulphitationpressmud cakes on yield, quality and nutrient of sugarcane. **Indian Sugar Crops. J., 13**: 1-5.

Table.1. Effect of TDE and fertilizers on Cane Yield (t/ha)

Treatments	S_1	S_2	S_3	S_4	S_5	Mean
M_1	32	54.6	49.8	44.8	40	**44.2**
M_2	41	58.6	58.1	54.9	52.4	**52.9**
M_3	48	62.8	62.4	61.5	59.8	**58.9**
M_4	51	65.5	65.3	64.1	61.9	**61.5**
Mean	**43**	**60.3**	**58.9**	**59.3**	**53.4**	
	M	S	M ×S	S ×M		
SE d	1.00	1.09	2.21	2.19		
CD (0.05)	2.5	2.2	4.7	4.5		

Table.2.Effect of TDE and fertilizers on available N content (kg ha^{-1}) of soil at different stages of sugarcane

Post harvest stage

Treatments	S_1	S_2	S_3	S_4	S_5	Mean
M_1	224	248	245	243	240	**240**
M_2	246	256	254	251	249	**251**
M_3	261	272	270	267	265	**267**
M_4	279	292	289	286	282	**286**
Mean	**253**	**267**	**265**	**262**	**259**	
	M	S	M ×S	S ×M		
SE d	4.40	3.89	8.25	7.80		
CD (0.05)	10	8	18	16		

Table.3.Effect of TDE and fertilizers on available P content (kg ha^{-1}) of soil at different stages of sugarcane

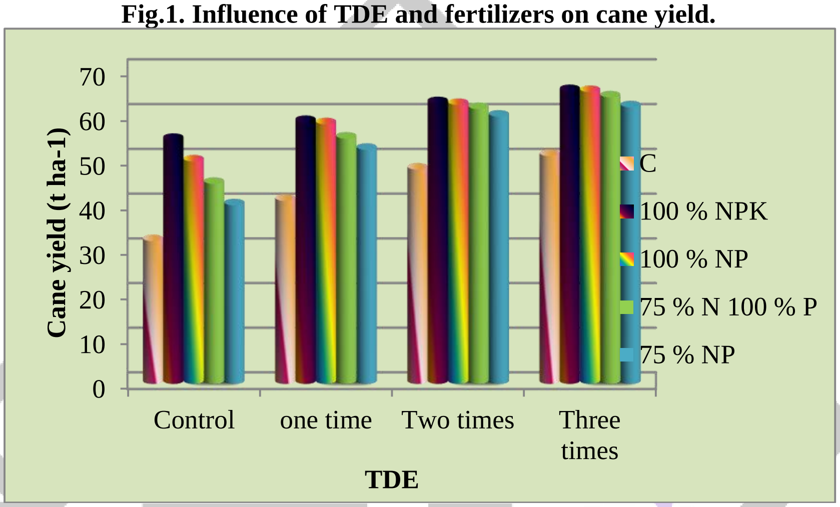
Post harvest stage

Treatments	S_1	S_2	S_3	S_4	S_5	Mean
M_1	18.2	18.9	18.7	18.5	18.4	**18.5**
M_2	19.2	20.3	20.2	20.0	19.9	**19.9**
M_3	20.8	21.6	21.5	21.2	20.8	**21.2**
M_4	22.9	23.6	23.5	23.2	23.1	**23.3**
Mean	**20.3**	**21.1**	**21.0**	**20.7**	**20.6**	
	M	S	M ×S	S ×M		
SE d	0.3	0.3	0.6	0.6		
CD (0.05)	0.8	0.6	1.3	1.2		

Table.4.Effect of TDE and fertilizers on available K content (kg ha^{-1}) of soil at different stages of sugarcane

Treatments	S_1	S_2	S_3	S_4	S_5	Mean
M_1	217	242	217	217	217	**222**
M_2	352	360	358	356	355	**356**
M_3	486	495	493	491	490	**491**
M_4	656	675	670	664	662	**665**
Mean	**428**	**443**	**435**	**432**	**431**	
	M	S	M ×S	S ×M		
SE d	8.15	4.02	10.88	8.03		
CD (0.05)	20	8	25	16		

Fig.1. Influence of TDE and fertilizers on cane yield.



SOIL: A PREREQUISTE FOR FOOD SECURITY AND HUMAN HEALTH

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***Abstract*: Soil health plays a crucial role in healthy food production and which results in local and global food security. Food security is achieved when all people have constant access to adequate, safe, and nutritious food that is economically accessible, socially acceptable, and allows for an active and healthy life. Soils are the basis for agriculture and the medium used for food production. Healthy soils produce healthy crops that in turn nourish people and animals. Indeed, soil quality is directly linked to food quality and quantity. Soils act as medium for production of healthy food, nutrient-rich growth medium for plants will result in plant tissues that contain most of the elements required for human life when the plants are consumed. Quality food production and food security have several components, including the production of sufficient amounts of food, adequate nutrient content in the food products, and the exclusion of potentially toxic compounds from the food products. Soils have a major role in all of these areas of quality food production and security which has influence on human health.**

***Keywords*: Soil, Food Security, Food Production, nutrients and Human health.**

Introduction

Soil health has been defined as the capacity of soil to function as a living system. Healthy soils maintain a diverse community of soil organisms that help to control plant disease, insect and weed pests, and form beneficial symbiotic associations with plant roots, recycle essential plant nutrients, improve soil structure with positive effects for soil water and nutrient holding capacity, and ultimately improve crop production. A healthy soil also contributes to mitigating climate change by maintaining or increasing its carbon content. Food availability relies on soils: nutritious and good quality food and animal fodder can only be produced if our soils are healthy. A healthy living soil is therefore a crucial ally to food security and nutrition.

Food Security

‘‘Food security exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food, which meets their dietary needs and food preferences for an active and healthy life’’ (FAO 2009).

Food security has four dimensions: (1) food production and availability through agronomic management of soil resources; (2) stability of food production and availability at all times; (3) food access through economic and physical capacity of households or communities; and, (4) food safety and utilization through nutritious and biological quality (FAO 2011a; Schmidhuber and Tubiello 2007).

Role of Soil Health in Food Security

Soil health is defined as ‘‘the capacity of a living soil to function within natural or managed ecosystem boundaries, to sustain plant and animal productivity, maintain and enhance water and air quality, and promote plant and animal health’’ (Doran 2002).

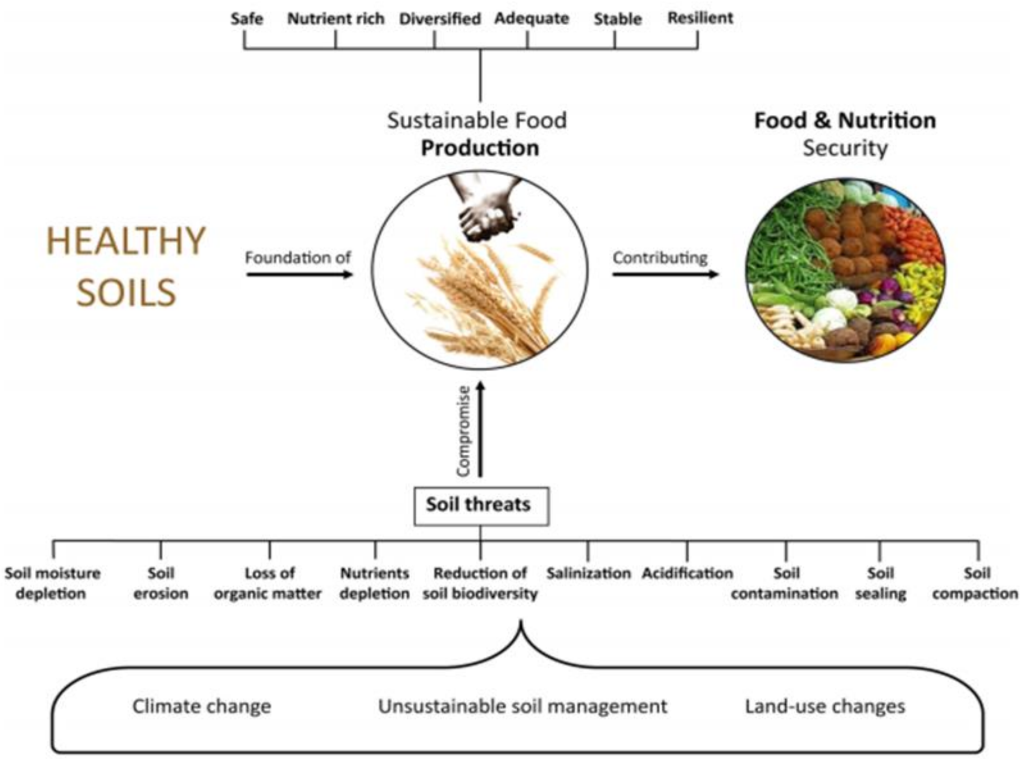

Figure 1: Role of Healthy Soil in Food Security

Nutrient impoverished soils contribute to systemic food and nutritional security issues. Over two billion people suffer from micro nutrient deficiencies, which are a significant cause of morbidity and mortality (Shetty 2009; Charles *et al.* 2010). Indeed, human (protein-energy) malnutrition is related to food scarcity and to the consumption of crops with low tissue concentrations of trace elements (*i.e*., iron, lithium, magnesium, zinc, copper, iodine), which are directly attributable to nutrient impoverished soils (St Clair and Lynch 2010). According to Shetty (2009), food of marginal quality coupled with a lack of dietary diversification imposes many associative costs on society such as poor health, reduced economic productivity and poor quality of life. The importance of healthy soils in assuring food security is depicted in Figure 1.

Role of Soil Nutrients in Food

Minerals are naturally occurring substances in the Earth's crust and vitamins are chemical substances found in food that is grown in the Earth or raised on plants. It is well understood that plant growth and crop yield depends on the nutrients present in the soil and as such, these nutrients can be modified to optimize both growth and yield. While some food plants and meat are richer sources of micro nutrients, the soil is the predetermining factor of micro nutrient levels in any plant. Crops grown in low-quality or deficient soils have lower nutrient content in both shoot and seed. Furthermore, soil type is an identifier of micro nutrient deficient populations (Brevik and Burgess, 2014).

Soils with low organic matter and highly weathered parent materials are prone to zinc deficiencies. Sedimentary rock, especially shale, is rich in iodine while igneous rock has very low levels of iodine. Iodine deficiency can leads to goiter, the first endemic disease attributed to the environment. Though iodine was among the first nutrients recognized as vital to humans today, deficiency affects 780 million people worldwide. Inadequate intake of iodine can result in a number of disorders including: miscarriage, stillbirths, cretinism (permanent, severe mental retardation, deaf-mutism and motor spasticity disorders), goiters, impaired mental function, retarded physical development and hypothyroidism. Iodine deficiency disorder is the leading cause of preventable brain damage in children worldwide and deficiency alone can lead to IQ levels 10 to 15 points lower than those with adequate levels of iodine consumption. In 1990, it was found that nearly 30 per cent of the world population was iodine deficient and 11 million people were affected by cretinism. When taking a closer look at Iodine Deficiency Disorder (IDD), it is found to characterize areas with low bio availability of iodine in soil (Steffan, 2018).

Another example is selenium deficiency and the prevalence of Keshin-Beck Disease in certain areas of China. Today, because of the great mobility of people and trading of food between regions/countries, the problem of diseases related to the environment seems less important, and tends to be neglected. However, firstly, one should note that the deficiency of trace elements can occur well before the development of illness and other visible symptoms; secondly, poverty stricken population often have less mobility and are largely reliant on what they can grow locally. Since in most cases, dietary intake is the predominant source of trace elements ingestion in humans, it is important that trace elements in the food supply chain.

In ancient China, people learnt to use seaweed to cure goiter, and in modern society fortified salt or other functional food are widely available to compliment of the deficiency of trace elements in food. However, for a better delivery mechanism, it has been argued that bio fortification (*i.e.*, improving trace element density in primary food sources, such as in cereals) is more widely accessible and more cost-effective.

In parallel to trace element deficiency, excessive concentrations of toxic elements in food are confounding the nutritional value of the food and causing health problems. One example would be cadmium contamination in rice and "itai-itai" disease. With rapid industrialization, there seems no end to toxic substances entering the environment, and efforts should be made to ensure that the entry of these toxic substances into our food supply chain is minimized.

Soil for Healthy People

Our health lies in our hand through the food we consume. We are what we eat. Since the food we eat is ultimately derived from soil, our health is likely to be influenced by the soil's chemical compositions, particularly trace elements, such as iodine, selenium, zinc and iron

Eleven elements comprise 99.9 per cent of the atoms found in the human body, subdivided into major and minor elements. Four major elements: H, O, C, and N make up about 99 per cent of the atoms in the body; seven minor elements: Na, K, Ca, Mg, P, S, and Cl make up an additional 0.9 per cent of the atoms in the body. In addition to these major and minor elements, there are approximately 18 additional elements considered essential in small amounts to maintain human life, although the exact number and identity of these elements is not universally agreed on by human health experts. These 18 additional elements, known as trace elements, include: lithium (Li), vanadium (V), chromium (Cr), manganese (Mn), iron (Fe), cobalt (Co), nickel (Ni), copper (Cu), zinc (Zn), tungsten (W), molybdenum (Mo), silicon (Si), selenium (Se), fluorine (F), iodine (I), arsenic (As), bromine (Br) and tin (Sn)For healthy human life 29 elements considered, 13 are essential plant nutrients obtained from the soil andanother five are elements obtained from the soil that are needed by some, but not all, plants. Although the elements Cr, W, Se, F, I, As, and Sn are not considered essential for plant health, these elements are also found in trace amounts in plants that grow in soils containing them.

Table 1: Some Important Plant-Tissue Sources of Elements Essential to Human Life

Element	Important Sources
Ca	Kale, collards, mustard greens, broccoli
Cu	Beans, peas, lentils, whole grains, nuts, peanuts, mushrooms, chocolate
I	Vegetables, cereals, fruit
K	Fruits, cereals, vegetables, beans, peas, lentils
Mg	Seeds, nuts, beans, peas, lentils, whole grains, dark green vegetables
Mo	Beans, peas, lentils dark green vegetables
Mn	Whole grains, beans, peas, lentils, nuts, tea
P	Nuts, beans, peas, lentils, grains
Se	Grain products, nuts, garlic, broccoli (if grown on high-Se soils)
Zn	Nuts, whole grains, beans, peas, lentils

Therefore, soils that provide a healthy, nutrient-rich growth medium for plants will result in plant tissues that contain many of the elements required for human life. In fact, most of the elements necessary for human life are obtained from either plant or animal tissues. Plant tissues are among the most important sources of Ca, P, Mg, K, Cu, Zn, Se, Mn, and Mo in the human diet (Table 1), and these elements are obtained by plants from the soil (Selinus *et al*., 2005).

Conclusion

Soils are fundamental to food security and thus to life on the planet. Soil healthy are a is important parameter for a healthy life. However, pressures imposed by human on soil resources are reaching critical limits, inherently decreasing or eliminating the functions of soil. Over 33 per cent of global soil resources are facing various forms of degradation, which if not addressed, will leads to serious food and nutrition security and hinder overall sustainable development. Unhealthy soils lead to systemic food and nutrient security problems that in turn result in malnutrition and hunger worldwide. Therefore, there is an ever-growing need to boost healthy soils for a healthy and food secure world.

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EFFECT OF ORGANIC PRACTICES ON AVAILABLE SOIL NUTRIENT STATUS IN BLACK PEPPER

Piper Nigrum L.

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Abstract: **To study the efficacy of organic practices on available soil nutrient status in black pepper, an experiment was undertaken at Horticultural Research Station, Yercaud, Tamil Nadu Agricultural University, and Coimbatore. Experiment was laid out with six treatments replicated four times in a randomized block design. Among the treatments of organic manures and biofertilizers viz., available soil NPK were recorded at initial stage (before the commencement of trial), flowering stage and harvesting stage. Higher nitrogen content of 168.19 kg ha^{-1} was recorded in the treatment T_3 at flowering stage and 153.63 kg ha^{-1} was recorded in the treatment T_3 at harvesting stage. Available phosphorous content of 8.35 kg ha^{-1} was recorded in the treatment T_2 at flowering stage and 7.44 kg ha^{-1} was recorded in the treatment T_2 at harvesting stage. Potassium content showed greater in T_5 (224.32 kg ha^{-1}) at flowering stage and (206.09 kg ha^{-1}) at harvesting stage compare to over control.**

Keywords: **FYM, Neem Cake, Azospirillum, Phosphobacteria, soil NPK, Black pepper.**

INTRODUCTION

Black pepper is an important spices crop in the world. Black pepper renowned as the ‘King of Spices’ and also termed as ‘Black gold’ is one of the most important spices contributing to commerce and trade in India.It is a perennial climbing vine grown for its berries, mainly used as spices and condiments. Black pepper is gaining worldwide for its flavour, taste and pungency alongwith the wide medicinal uses (Sharangi and Kumar, 2011). Kerala accounts for 80-90% of the total black pepper production in the country. The demand of organic spices throughout the world provides ample scope to go for organic substitution in black pepper (Stephen and Nybe, 2003).

Black pepper is a crop responding to heavy dozes of organic manures. Continuous uses of inorganic chemical fertilizers negatively affect the soil health and crop quality. It is essential to reduce the indiscriminate use of inorganic chemical fertilizer and simultaneously use of different bio-fertilizers and organic nutrient sources.The study was, undertaken to evaluate the effect of organics practices on available soil nutrient status in black pepper.

MATERIALS AND METHODS

The experiment was conducted to assess the efficacy oforganic practices on available soil nutrient status in black pepper at the Horticultural Research Station, Yercaud, Tamil Nadu Agricultural University, Coimbatore during the period June 2008 to April 2009 with the variety Panniyur - 1 . There were six treatments namely T_1- FYM 10 Kg + 5 Kg Coir Compost + 50 g Phosphobacteria + 50 g Azospirillum, T_2 - FYM 10 Kg + 1 Kg Vermi Compost + 50 g Phosphobacteria, T_3 - FYM 10 kg + 1 Kg Neem Cake + 50 g Phosphobacteria + 50 g Azospirillum, T_4 - FYM 10 Kg + 50 g Azospirillum + 50 g Phosphobacteria, T_5 - FYM 10 Kg + 50 g Azospirillum + 50 g Phosphobacteria + 200 g VAM and T_6 - 100 g of N + 40 g of P_2O_5 + 140 g of K_2O (Recommended dose for Package of Practices - Control) replicated four times in a randomized block design.

The observations on soil nutrient content viz., available N, available P_2O_5 and available K_2O were recorded at initial stage (before the commencement of trial), flowering stage and harvesting stage respectively.

RESULTS AND DISCUSSIONS

Soil nitrogen content

The initial nitrogen content in the soil was 156.18 kg ha^{-1}. At flowering stage , the nitrogen content ranged from 157.72 kg ha^{-1} (T_6) to 168.19 kg ha^{-1} (T_3)(Table 1). At harvesting stage the range was 135.11 kg ha^{-1} (T_6) to 153.63 kg ha^{-1} (T_3). Higher nitrogen content of 168.19 kg ha^{-1} was recorded in the treatment T_3 at flowering stage and 153.63 kg ha^{-1} was recorded in the treatment T_3 at harvesting stage. T_6 treatment recorded significantly lower levels of nitrogen in both the stages (157.72 and 135.11 kg ha^{-}1) at both the stages and the treatments T_4 were on par with them.

Farmyard manure could supply 5.0 Kg N ton^{-1} (Katyayan, 2001) and Neem Cake contains 5.6 % of N. So the increase in the contents of total nitrogen in the soil might be attributed to the better availability of nitrogen coupled with related nitrification process enabling presence of nitrogen for a longer period in the soil. This is in corroboration with previous findings of Guminski (1968). Azospirillum would have enhanced the soil available nitrogen because of its non-symbiotic nitrogen fixation. This is in confirmation with earlier observation of Okon (1982). Similarly, Azospirillum might be responsible for the promotion of availability of ion by scavenging the nutrients. The present study is in consonance with the findings of Lin *et al*. (1983) and Sathiyavathi and Ramanathan (2001).

Table 1: Effect of organic practices on soil available N content

Treatments	Initial stage	Flowering stage	Harvesting stage
T_1	156.18	165.52	152.11
T_2		168.11	144.35
T_3		168.19	153.63
T_4		158.34	135.82
T_5		161.67	145.86
T_6		157.72	135.11
SEd		2.3482	2.0826
CD		5.0052	4.4390

T_1 - FYM 10 Kg + 5 Kg Coir compost + 50 g Phosphobacteria + 50 g Azospirillum	T_4 - FYM 10 Kg +50 g Azospirillum + 50 g Phosphobacteria
T_2 - FYM 10 Kg + 1 Kg Vermicompost + 50g Phosphobacteria	T_5 - FYM 10 Kg + 50 g Azospirillum + 50 g Phosphobacteria + 200 g VAM
T_3 - FYM 10 Kg + 1 Kg Neem cake + 50 g Phosphobacteria + 50 g Azospirillum	T_6 - 100 g of N + 40 g of P_2O_5 + 140 g K_20 (Control)

Soil phosphorus content

From the initial 7.56 kg ha^{-1} the soil phosphorus content increased to 7.71 kg ha^{-1} in T_6 and 8.35 kg ha^{-1} in T_2 at flowering stage (Table 2). The range was 6.90 kg ha^{-1} (T_6) to 7.44 kg ha^{-1} (T_2) at harvesting stage. Higher phosphorous content of 8.35 kg ha^{-1} was recorded in the treatment T_2 at flowering stage and 7.44 was recorded in the treatment T_2 at harvesting stage. T_6 treatment recorded significantly lower level of phosphorous (7.71 and 6.90 kg ha^{-}1) at both the stages and the treatments T_4 was on par with them.

Organic nitrogen and P_2O_5 availability in the soil increased with the application of FYM, Vermicompost, Azospirillum and Phosphobacteria due to the increase of decomposition of products of organic matter. This is in confirmation with the previous works of Ismail *et al*. (1998). Moreover, vermicompost possesses high 'P' content. Application of vermicompost in this treatment could be responsible for the high soil 'P' content. The inoculation of phosphobacteria resulted in the increased availability of phosphorous, since these bacteria helps to degrade the complex forms of phosphate into more soluble and simple forms of phosphorous. The present investigation is in agreement with that of Golebiowska *et al*. (1964), Hayman (1975), Tinkler and Sandens (1975) and Gaur (1985).

Table 2: Effect of organic practices on soil available phosphorous (kg ha $^{-1}$)

Treatments	Initial stage	Flowering stage	Harvesting stage
T_1	7.56	8.12	7.35
T_2		8.35	7.44
T_3		8.21	7.28
T_4		7.89	7.09
T_5		8.09	7.10
T_6		7.71	6.90
SEd		0.1151	0.1039
CD		0.2454	0.2215

T_1 - FYM 10 Kg + 5 Kg Coir compost + 50 g Phosphobacteria + 50 g Azospirillum	T_4 - FYM 10 Kg +50 g Azospirillum + 50 g Phosphobacteria
T_2 - FYM 10 Kg + 1 Kg Vermicompost + 50g Phosphobacteria	T_5 - FYM 10 Kg + 50 g Azospirillum + 50 g Phosphobacteria + 200 g VAM
T_3 - FYM 10 Kg + 1 Kg Neem cake + 50 g Phosphobacteria + 50 g Azospirillum	T_6 - 100 g of N + 40 g of P_2O_5 + 140 g K_20 (Control)

Soil Potassium Content

The combined application of FYM, Azospirillum, Phosphobacteria and VAM showed greater potassium content (224.32 per cent) at flowering stage and (206.09 per cent) at harvesting stage. The lower potassium content was observed in T6 (214.20 and 192.11 per cent) at both the stages (Table 3).

The highest potassium content in soil was noticed under the application of FYM along with Azospirillum, Phosphobacteria and VAM. This could be due to the application of FYM, which helps to convert into soil humus substances and mobilization of potassium due to the exchange reaction with soil particles. This is in corroboration with the previous works of Adherkhin and Belyayer (1971). Azospirillum may also be ascribed to enhance the availability of potassium.

Table 3: Effect of organic practices on soil available potassium (kg ha $^{-1}$)

Treatments	Initial stage	Flowering stage	Harvesting stage
T_1	210.6	215.54	201.22
T_2		219.65	203.14
T_3		221.34	205.48
T_4		217.36	202.88
T_5		224.32	206.09
T_6		214.20	192.11
SEd		3.1457	2.9018
CD		6.7050	6.1851

T_1 - FYM 10 Kg + 5 Kg Coir compost + 50 g Phosphobacteria + 50 g Azospirillum	T_4 - FYM 10 Kg +50 g Azospirillum + 50 g Phosphobacteria
T_2 - FYM 10 Kg + 1 Kg Vermicompost + 50g Phosphobacteria	T_5 - FYM 10 Kg + 50 g Azospirillum + 50 g Phosphobacteria + 200 g VAM
T_3 - FYM 10 Kg + 1 Kg Neem cake + 50 g Phosphobacteria + 50 g Azospirillum	T_6 - 100 g of N + 40 g of P_2O_5 + 140 g K_20 (Control)

CONCLUSION

From the present investigation the results indicated that treatments involving complete organic and biofertilizer exhibited higher values in the available major soil nutrient status in all the stages.

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Total Nitrogen, Phosphorus and Potassium uptake by plants due to the Effect of Integrated Nutrient Management in Ashgourd (Benincasa hispida Cogn.) Cv. Co-1

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Abstract: **An investigation on Total Nitrogen, Phosphorus and Potassium uptake by plants due to the Effect of integrated nutrient management in ashgourd (Benincasa hispida cogn.) cv. CO-1 was undertaken at Department of Horticulture, Don Bosco College of Agriculture, Sagayathottam. The results of the study indicated that the computed data pertaining to the total nutrient uptake by the plants due to the effect of various organic and inorganic inputs was observed in the treatment PM @ 3 kg pit^{-1} plus 75 per cent RDF plus EM @ 1:1000 dilution plus panchakavya @ 3 per cent had recorded the highest NPK uptake by the plants in the soil.**

Keywords: **INM, Ashgourd, Nutrient uptake, NPK.**

Ashgourd (Benincasa hispida cogn.) is one of the important member of the family Cucurbitaceae. It is cultivated in almost every part of India. Ashgourd is a vigorous but slow growing trailing annual. Due to long tap root system, ash gourd is considered as an ideal crop for river bed cultivation. Stem and all other parts are covered with bristle like hairs. This monoecious crop produces large male flowers with long pedicels and female flowers with densely haired ovary and short peduncle on same plant (Gopalakrishnan, 2007). **The flesh of fruit is white to pale green, with a rather bland flavour (Marr et al., 2007).**

In India, the crop is widely grown in UP and Delhi for preparation of 'Agra petha' and in southern states for use as vegetable. Ash gourd is also useful in treating respiratory disorders like asthma, blood related diseases, and urinary diseases like kidney stones (Paul, 2012). It is an excellent source of vitamin B1 (Thiamine), a good source of vitamin B3 (Niacin), and vitamin C. It is also rich in many minerals like calcium. Among the various strategies followed to improve the crop productivity and sustainability, integrated nutrient management plays a vital role. Integrated nutrient management refers to the maintenance of soil fertility and of plant nutrient supply at an optimum level for sustaining the desired productivity through optimization of the benefits from all possible sources of organic, and inorganic inputs *viz.,* Farm yard manure, Poultry manure, Panchakavya, Effective microorganisms, and Recommended dose of fertilizers (RDF) are very effective to improve the growth, yield and quality characters. Hence, the present study was conducted to find out the suitable combination of organic nutrients and inorganic fertilizer are nutrient uptake levels of Nitrogen, Phosphorus and Potassium by ashgourd (*Benincasa hispida* cogn.) cv.CO-1.

MATERIALS AND METHODS

The present experiment on "Effect of integrated nutrient management on growth and flowering characters in ashgourd (*Benincasa hispida* cogn.) cv. CO-1." was undertaken at Department of Horticulture, Faculty and Agriculture, Annamalai University, Annamalai Nagar during 2013-2014. The experiments includes six treatments *viz.,* T1 - FYM + 100 % RDF, T2 - FYM + 75 % RDF + EM, T3 - FYM + 75 % RDF + Panchakavya, T4 - FYM + 75 % RDF + EM + Panchakavya, T5 - PM + 100 % RDF, T6 - PM + 75 % RDF + EM, T7 - PM + 75 % RDF + Panchakavya, T8 - PM + 75 % RDF + EM + Panchakavya, T9 - FYM + 50 % RDF + EM, T10 - FYM + 50 % RDF + Panchakavya, T11 - FYM + 50 % RDF + EM+ Panchakavya, T12 - PM + 50 % RDF + EM, T13 - PM + 50 % RDF + Panchakavya, T14 - PM + 50 % RDF + EM + Panchakavya. (FYM-Farmyard manure, PM-Poultry manure, RDF-Recommended dose of fertilizer as soil application, EM-Effective microorganisms and Panchakavya as foliar spray).

The experiment was laid out in a Randomized Block Design and replicated in three times. Plant nutrient analysis *viz.,* Nitrogen uptake, Phosphorous uptake and Potassium uptake were taken from plant samples collected from the individual treatment at the time of harvest were dried in an oven at 600 C, powdered in a Willey mill and analysed for total nutrient content. The data were subjected to statistical analysis as suggested by Panse and Sukhatme, 1978. The site is geographically situated at 13^{o} 02' N latitude 79^{o} 77' E longitude and at an altitude of + 91 m above mean sea level in the Vellore District of Tamilnadu. The soil of the experimental plot is sandy loam with pH of 8.1 and EC 0.76 millimhos cm-1.

RESULTS AND DISCUSSION

Effect of INM on nutrient uptake in ashgourd (Benincasa hispida cogn.) cv. CO-1. Nitrogen uptake

The computed data pertaining to the nitrogen uptake by plants due to the effect of various organic and inorganic inputs are presented in table 1. Significant influences were observed between the treatments for this trait. Among the various treatments, the highest nitrogen uptake was observed in the treatment T8 (91.56 kg ha-1), followed by T4 (88.24 kg ha-1). The lowest nitrogen uptake was recorded in the treatment T9 (62.87 kg ha-1).

Phosphorus uptake

The data recorded on phosphorus uptake by plants are presented in the table 2. Significant variations were noticed among the treatments with respect to phosphorus uptake by plant. Application of PM @ 3 kg pit-1 plus 75 per cent RDF plus EM @ 1:1000 dilution plus panchakavya @ 3 per cent (T8) had resulted in the maximum uptake of phosphorus by the plants (43.27 kg ha-1). The treatment T4 (FYM @ 10 kg pit-1 plus 75 per cent RDF plus EM @ 1:1000 dilution plus panchakavya @ 3 per cent) was found to be the next best (40.82 kg ha-1). The least value of 15.68 kg ha-1 was observed in T9 (FYM @ 10 kg pit-1 plus 50 per cent RDF plus EM @ 1:1000 dilution).

Potassium uptake

The data recorded on the effect of INM on potassium uptake of the plants is furnished in the table 3. The maximum potassium uptake by the plants (83.69 kg ha-1) was observed in the treatment T8 which received application of PM @ 3 kg pit-1 plus 75 per cent RDF plus EM @ 1:1000 dilution plus panchakavya @ 3 per cent. Application of FYM @ 10 kg pit-1 plus 75 per cent RDF plus EM @ 1:1000 dilution plus panchakavya @ 3 per cent (T4) had recorded the next best value (80.45 kg ha-1). The potassium uptake was found to be the least in the treatment T9 (51.69 kg ha-1).

The increased uptake of major nutrients in the best treatment could be due to the chemolitho autotropic nitrifers (Ammonifers and Nitrifers) which colonize in the leaves leading to increased ammonia uptake and enhanced the total N supply. The presence of chemolithic autotropic nitrites in panchakavya might have contributed to plant nutrition both directly and indirectly. Added organic manure (PM) along with panchakavya not only acted as a sources of nutrients, but also had influenced the availability of nutrients slowly and steadily throughout the period of the crop growth. This could also be attributed to the more rapid decomposition of organic matter and greater nutrient release due to the application of EM.

Table 1. Effect of INM on nutrient uptake in ashgourd (*Benincasa hispida* cogn.) cv. CO-1.

Treatments		Nutrient uptake (kg ha^{-1})
		Nitrogen (N)
T_1	FYM + 100 % RDF	76.82
T_2	FYM + 75 % RDF + EM	81.02
T_3	FYM + 75 % RDF + Panchakavya	82.16
T_4	FYM + 75 % RDF + EM + Panchakavya	88.24
T_5	PM + 100 % RDF	77.29
T_6	PM + 75 % RDF + EM	84.68
T_7	PM + 75 % RDF + Panchakavya	85.72
T_8	PM + 75 % RDF + EM + Panchakavya	91.56
T_9	FYM + 50 % RDF + EM	62.87
T_{10}	FYM + 50 % RDF + Panchakavya	67.45
T_{11}	FYM + 50 % RDF + EM + Panchakavya	72.11
T_{12}	PM + 50 % RDF + EM	66.21
T_{13}	PM + 50 % RDF + Panchakavya	70.98
T_{14}	PM + 50 % RDF + EM + Panchakavya	75.97
SEd		0.99
CD (p=0.05)		0.24

Table 2. Effect of INM on nutrient uptake in ashgourd (*Benincasa hispida* cogn.) cv. CO-1.

Treatments		Nutrient uptake (kg ha^{-1})
		Phosphorous (P)
T_1	FYM + 100 % RDF	30.65
T_2	FYM + 75 % RDF + EM	33.41
T_3	FYM + 75 % RDF + Panchakavya	34.27
T_4	FYM + 75 % RDF + EM + Panchakavya	40.82
T_5	PM + 100 % RDF	31.04
T_6	PM + 75 % RDF + EM	37.33
T_7	PM + 75 % RDF + Panchakavya	38.12
T_8	PM + 75 % RDF + EM + Panchakavya	43.27
T_9	FYM + 50 % RDF + EM	15.68
T_{10}	FYM + 50 % RDF + Panchakavya	20.55
T_{11}	FYM + 50 % RDF + EM + Panchakavya	25.33
T_{12}	PM + 50 % RDF + EM	19.68
T_{13}	PM + 50 % RDF + Panchakavya	24.17
T_{14}	PM + 50 % RDF + EM + Panchakavya	29.45
SEd		0.95
CD (p=0.05)		1.97

Table 3. Effect of INM on nutrient uptake in ashgourd (*Benincasa hispida* cogn.) cv. CO-1.

Treatments		Nutrient uptake (kg ha^{-1})
		Potassium (K)
T_1	FYM + 100 % RDF	66.14
T_2	FYM + 75 % RDF + EM	71.02
T_3	FYM + 75 % RDF + Panchakavya	72.41
T_4	FYM + 75 % RDF + EM + Panchakavya	80.45
T_5	PM + 100 % RDF	67.32
T_6	PM + 75 % RDF + EM	76.11
T_7	PM + 75 % RDF + Panchakavya	77.76
T_8	PM + 75 % RDF + EM + Panchakavya	83.69
T_9	FYM + 50 % RDF + EM	51.69
T_{10}	FYM + 50 % RDF + Panchakavya	56.51
T_{11}	FYM + 50 % RDF + EM + Panchakavya	61.17
T_{12}	PM + 50 % RDF + EM	55.23
T_{13}	PM + 50 % RDF + Panchakavya	59.91
T_{14}	PM + 50 % RDF + EM + Panchakavya	65.02
SEd		1.11
CD (p=0.05)		2.30

From the present investigation, it may be concluded that The plant nutrient uptake was observed to be the highest (91.56 kg ha-1 N, 43.27 kg ha-1 P and 83.69 kg ha-1 K) in the treatment T8 which received the application of PM @ 3 kg pit-1 plus 75 per cent RDF plus EM 1:1000 dilution plus panchakavya @ 3 per cent.

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ABSTRACT

SOIL IS ALIVE BUT IT'S HUNGRY

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Abstract: Soil is a mixture of organic matter, minerals, gases, liquids, and organisms that together support life. Soil is also commonly referred to as earth or dirt; some scientific definitions distinguish *dirt* from *soil* by restricting the former term specifically to displaced soil.

Soil is alive

Grab a handful of soil, what are you holding in your hand? A mixture of minerals and air with some water and organic matter? Is that all? No. There's so much more to soil than that. Not every organism is identical, or as abundant, or does the same things, or is active at the same time. Some you can see and some you can't, although we have various tools we can use to prove even the microscopic ones exist. Soil is the most immensely complicated and diverse ecosystem on the planet, and as the quotations above suggest, its care and feeding are vital to agriculture and vital to life. The soil is the skin of the Earth. Without it the Earth - ourselves included - would also die. The soil provides our food, recirculates our air, and purifies our water. It does so constantly, quietly, and through agents mostly unseen. In every square yard of soil there may be thousands of different species present. If you think about bacteria alone, a single gram of soil (about as much as a raisin) can have as many as 10,000 unique genetic signatures. A good grassland soil will have 2 to 4 tons of biomass per acre.

Roles of organisms

Decomposition and predation are two important roles soil organisms play. They are critical to nutrient cycling. Truth be told, predatory organisms in soil are rather messy eaters and leave behind many nutrients for plants to take up. That's one reason why predators, such as nematodes, are actually very beneficial to plant growth. In terms of soil ecosystem functions critical to grasslands, **decomposition and carbon cycling, nutrient cycling, biological population regulation, and soil structure and maintenance** are key roles organisms play.

- The major organisms involved in decomposition and nutrient cycling are the bacteria and fungi and in regulating population are the nematodes and micro fauna.
- The major organisms affecting soil structure and large pores are earthworms, ants, and beetles burrowing into the soil profile. Even when organisms die in soil they aren't yet finished playing an active role.
- There are proteins called extracellular enzymes excreted into the soil environment by living and dead organisms that maintain biological activity. This turns out to be very useful in nutrient cycling for elements such as phosphorus (P).
- Large organisms such as earthworms and ants are ecosystem engineers. They burrow into soil making channels, mix organic matter (like dung beetles), and help bring leached nutrients up to the soil surface.

Soil is hungry

"Soil degradation affects food production, causing hunger and malnutrition, amplifying food-price volatility, forcing land abandonment and involuntary migration-leading millions into poverty. The FAO Status of the World's Soil Resources report has identified 10 major threats to soil functions including soil erosion, soil nutrient imbalance, soil carbon and biodiversity losses, soil acidification, contamination, soil salinization, and soil compaction. So these are the degradation process leads to soil hungry. So Sustainable soil management as an "essential part of the Zero Hunger equation" in a world where more than 815 million people are suffering from hunger and malnutrition. Soils act as filters for contaminants, preventing their entry into the food chain and reaching water bodies such as rivers, lakes, seas and oceans, but that this potential is limited when contamination exceeds the capacity of soils to cope with pollution.

Management of hunger soil

- Proper use of soil
- Go for integrated crop cultivation
- Regular recharging of nutrients
- Organic cultivation
- Test your soil.

- Add organic matter.
- Incorporate compost to compacted soil to increase air, water and nutrients for plants.
- Protect topsoil with mulch or cover crops.
- Don't use chemicals unless there's no alternative.
- Rotate crops.

SOIL HEALTH

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Soil health

The terms 'soil health' and 'soil quality' are becoming increasingly familiar worldwide. A modern consensus definition of soil health is **"the continued capacity of the soil to function as a vital living ecosystem that sustains plants, animals and humans" (NRCS, 2015)**.

Increasing demand, and by the awareness of the environmental and human health damage induced by overuse of pesticides and fertilizers worldwide agricultural practice is moving to a more sustainable and environmental friendly approach. Organic matter is known to improve soil health and availability of plant nutrients. In recent years, soil application of organic wastes has emerged as an attractive and cost effective alternate strategy for wastes management around the world. The composted or uncomposted organic waste material is applied in huge quantities to supply the required quantity of nutrients in agricultural systems.

Soil quality as **"the capacity of a soil to function, within ecosystem and land use boundaries, to sustain productivity, maintain environmental quality, and promote plant and animal health." (Doran and Parkin)**

Soil Quality Indices

Scientists use **soil quality indicators** to evaluate how well soil functions since soil function often cannot be directly measured. Soil quality indicators may be qualitative (e.g. drainage is fast) or quantitative (infiltration= 2.5 in/hr).

Ideal indicators should:

- correlate well with ecosystem processes
- integrate soil physical, chemical, and biological properties & processes
- be accessible to many users
- be sensitive to management & climate
- be components of existing databases
- be interpretable

There are three main categories of soil indicators: **chemical, physical and biological**. Typical soil tests only look at chemical indicators. Soil quality attempts to integrate all three types of indicators. The categories do not neatly align with the various soil functions, so integration is necessary. The table below shows the relationship between indicator type and soil function.

Indicator Categories

Physical indicators provide information about soil hydrologic characteristics, such as water entry and retention that influences availability to plants. Some indicators are related to nutrient availability by their influence on rooting volume and aeration status. Other measure tells us about erosional status. Indicators include measures of:

- **Aggregate Stability**
- **Available Water Capcity**
- **Bulk Density**
- **Infiltration**
- **Slaking**
- **Soil Structure and Macropores**

Chemical indicators can give you information about the equilibrium between soil solution (soil water and nutrients) and exchange sites (clay particles, organic matter); plant health; the nutritional requirements of plant and soil animal communities; and levels of soil contaminants and their availability for uptake by animals and plants. Indicators include measures of:

- Electrical Conductivity
- Soil Nitrate

- **Soil Reaction (pH)**

  Soil pH generally refers to the degree of soil acidity or alkalinity. Chemically, it is defined as the log10 hydrogen ions (H+) in the soil solution.

    - The pH scale ranges from 0 to 14; a pH of 7 is considered neutral.
    - If pH values are greater than 7, the solution is considered basic or alkaline; if they are below 7, the solution is acidic.
    - Soil pH affects the soil's physical, chemical, and biological properties and processes, as well as plant growth.
    - The nutrition, growth, and yields of most crops decrease where pH is low and increase as pH rises to an optimum level

Biological indicators:

It can tell us about the organisms that form the soil food web that are responsible for decomposition of organic matter and nutrient cycling.

Information about the numbers of organisms, both individuals and species, that perform similar jobs or niches, can indicate a soil's ability to function or bounce back after disturbance (resistance and resilience).

Indicators include measures of:

- Earthworms
- Particulate Organic Matter
- Respiration
- Soil Enzymes
- Total Organic Carbon.

THERI SOILS

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Red sandy dunal soils of Tamil Nadu is called Theri soils. They occupy about 20,000 ha. Tirunelveli and Tuticorin district has the largest area under the coverage of this soil. Theries are soils formed in a isomegathermic and ustic regimes from geogenic sand deposits under a climate with mean annual temperture of 28 to 32^0 C and 700 mm of annual rainfall. The soil colour is 2.5 YR with a variation from 5 YR to 10 R.

The soils are extremely deep except due to lithological discontinuity. Texture ranges from single grain to sandy loam. Structure is fine weak subangular blocky to very coarse strong angular blocky. Soils are moderately acidic with low organic carbon content. The soils are dominated by heavy minerals like limonite and zircon and a little rutile, monasite and garnet and quyartz in light mineral fraction.

The Advantages of Theri lands are deep sand zone, good permeability and quality ground water. The Disadvantages of Theri lands are unsuitable for agriculture, the surface of the soil is not plane, higher level of soil erosion, sand dunes, from the top to the bottom only sand, low nutrients and minerals and Low water holding capacity.

Tank silt and various organic amendments are the materials used to improve the fertility constraints of this soil. To convert this soil into a cultivable land to improve the soil moisture characteristics of the soil using soil amendment.

EFFECT OF INTEGRATED NUTRIENT MANAGEMENT IN CUCUMBER (*Cucumis sativus* L.)

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An investigation entitled "Effect of Integrated Nutrient Management in Cucumber (*Cucumis sativus* L.)" was carried out in the Orchard, Department of Horticulture, Don Bosco College of Agriculture, Sagayathottam, during 2017-2018.

The experiment was conducted by using soil application of different organic and inorganic inputs *viz.*, Farm yard manure, Vermicompost, Panchakavya, Effective microorganisms, and Recommended dose of fertilizers (RDF). It was laid out in randomized block design with 11 treatment combinations in three replications. The Farm yard manure was applied @ 10 kg/pit, Vermicompost @ 3 kg/pit and Effective microorganisms 1:100 dilution, were given as soil application.

The results of the present investigation revealed that, the soil application of VC @ 3 kg pit^{-1} plus 75 per cent RDF plus EM 1:1000 dilution had recorded the maximum positive response for growth and flowering characters like early germination, vine length, number of leaves per vine, number of male flowers per vine, number of female flowers per vine and sex ratio.

The yield attributes *viz.*, number of fruits per vine, single fruit weight, fruit length, fruit yield per vine and fruit yield per hectare were also found to be the highest in the same treatment. The plant nutrient uptake was also markedly increased by this treatment.

With regard to the post harvest available soil nutrients, the results revealed that application of FYM @ 10 kg pit-1 plus 50 per cent RDF plus EM @ 1:1000 dilution had recorded the highest NPK content in the soil.

BIODIVERSITY

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Biodiversity is the variety and variability of life on Earth. It is typically a measure of variation at the genetic, species, and ecosystem level. Terrestrial biodiversity is usually greater near the equator, which is the result of the warm climate and high primary productivity. Biodiversity is not distributed evenly on Earth, and is richer in the tropics. These tropical forest ecosystems cover less than 10 percent of earth's surface, and contain about 90 percent of the world's species. Marine biodiversity is usually higher along coasts in the Western Pacific, where sea surface temperature is highest, and in the mid-latitudinal band in all oceans. Although the abundance of bacteria, fungi, protozoan's and animals in soil is astounding, most taxa and their natural history have hardly been described. The most abundant group of organisms in soil is bacteria.

One gram of soil can contain up to 109 bacterial cells, constituting up to 104 species. Bacteria can benefit plant growth directly by stimulating root branching and root hair development and indirectly by dispersing pathogens.

- Bacteria also regulate biogeochemical cycling, influence atmospheric chemistry and climate through the production and consumption of trace gases and degrade organic contaminants in soil.
- The abundance of viruses actually exceeds prokaryotes, and as such, viral-induced bacteria mortality has consequence for biogeochemical cycling and other ecosystem services provided by soil. Eukaryotes are also abundant in soil.
- One gram of soil can also contain >100 m of fungal hyphae. Although some fungi are pathogenic to plants, their hyphae entangle soil and play an important role in soil aggregation and plant nutrient use.
- Ten to hundreds of thousands of protozoa (single-celled eukaryotes) can also be found in a gram of soil, and their feeding on bacteria and fungi stimulates nutrient turnover.
- Nematodes can be the most numerous of all animals in the soil and occupy all consumer trophic levels as bacteria feeders, fungi feeders, root herbivores, predators and omnivores – contributing to the great complexity of soil foodwebs.
- Micro arthropod (collembolans and mites) abundances range from 103 to 105 individuals per square metre of soil, and despite the key role they play in decomposition only 10% of the species have been explored or described Enchytraeids are miniature, unpigmented earthworms that ingest organic matter, soil particles and associated bacteria and fungi.
- The soil macro fauna include insects, isopods, earthworms, spiders, centipedes, millipedes and other invertebrates >10 mm in length.
- Soil macro arthropods influence primary productivity, pedogenesis, belowground food webs, litter decomposition, nutrient cycling, soil structure, water infiltration, soil fertility and greenhouse gas emissions. For example, bioturbation by dung beetles increases water infiltration, N mineralization and plant productivity.
- Soil-dwelling ants benefit plant growth by modifying biotic and abiotic aspects of soil (e.g. structure, moisture content, and nutrient availability) and increasing mycorrhizal colonization.
- Earthworms have been studied extensively because they are ecosystem engineers and can increase yield in agro ecosystems.
- Earthworms have a positive effect on plant growth by improving soil structure to retain more water, stimulating microbial turnover, increasing N mineralization and dispersing microorganisms antagonistic to root pathogens. Earthworms can also modify the soil seed bank and composition of germinating seeds.
- Their exudates and physical incorporation of organic matter in soil promotes aggregate formation and stability.
- Earthworm-mediated formation of large microaggregates that contain stable microaggregates is an important mechanism in organic matter protection.
- While soil bacteria and fungi ultimately mediate many soil processes that underpin ecosystem services, their functioning is influenced by macro fauna that reinforce a system state favorable to those organisms and the ecosystem services they provide.
- Agricultural intensification compromises ecosystem services through negative impacts to soil health and soil biodiversity.

Importance of biodiversity

- Increase ecosystem productivity; each species in an ecosystem has a specific role to play.
- Support a larger number of plant species and, therefore, a greater variety of crops.
- Protect freshwater resources.
- Promote soils formation and protection.
- Provide for nutrient storage and recycling.
- Aid in breaking down pollutants.

- Contribute to climate stability.
- Speed recovery from natural disasters.
- Provide more food resources.
- Provide more medicinal resources and pharmaceutical drugs.
- Offer environments for recreation and tourism.

SOIL ECOSYSTEM

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Soils are rich ecosystems, composed of both living and non-living matter with a multitude of interaction between them. Soils play an important role in all of our natural **ecological cycles** viz.., **carbon, nitrogen, oxygen, water and nutrient**. They also provide benefits through their contribution in a number of additional processes, called **ecosystem services**. These services range from waste decomposition to acting as a water filtration system to degrading environmental contaminants.

The diversity and abundance of life that exists within the soil is greater than in any other ecosystem. A handful of soil can contain billions of different organisms that play a critical role in soil quality to support plant growth. Although we understand the vital services that these organisms provide by breaking down organic debris (plants, animals, and other organic materials) and recycling nutrients, scientists have only begun to study the rich and unique diversity that is a part of the soil ecosystem.

Ecological Cycling

Each ecological cycle is unique, although similar elements can appear in more than one cycle. While most move between the atmosphere (air), hydrosphere (water), lithosphere (land) and biosphere (living things), other **nutrient cycles** are limited to movement between rocks and soils and plants and animals. However, even the nutrients from these limited cycles, such as potassium, calcium, phosphorus and magnesium, are essential for life.

- **Water and nitrogen resources,** both essential to all living things, stay constant within their cycles—meaning their only change is in the forms they take.
- The **water cycle** is very dynamic as water can change from vapor to liquid to snow to ice.
- Soils role in this process is through infiltration, storage, and transpiration.
- Nitrogen, which makes up more than three-quarters of the Earth's atmosphere, must be broken down into other forms in order to be used by living organisms. It is within the **nitrogen cycle** that soil bacteria converts nitrogen into usable elements (called nitrogen fixing) for plants, animals and humans before it is eventually returned to the atmosphere.

Oxygen is unique in that it not only has its own cycle, it is often integrated into elements within other ecological cycles, as water (H2O), carbon dioxide (CO2), iron oxide (Fe2O3), and many others. Within the biosphere, photosynthesis is the key driver of the **oxygen cycle** as plants take in carbon dioxide and expel **oxygen for animal and human use**.

The carbon cycle is by far the cycle of greatest interest due to its importance in both climate change and global warming.

- The **biological/physical carbon cycle** occurs over days, weeks, months, and years and involves the absorption, conversion, and release of carbon by living organisms through photosynthesis, respiration, and decomposition.

Ecosystem Services

Ecosystem services are the many and varied benefits that humans freely gain from the natural environment and from properly-functioning ecosystems. Such ecosystems include agro ecosystems, forest ecosystems, grassland ecosystems and aquatic ecosystems. This ecosystem functioning properly provides such things like agricultural produce, timber, and aquatic organisms such as fishes and crabs. Collectively, these benefits are becoming known as 'ecosystem services', and are often integral to the provisioning of clean drinking water, the decomposition of wastes, and the natural pollination of crops and other plants.

Supporting services

These include services such as nutrient recycling, primary production, soil formation, habitat provision and pollination. These services make it possible for the ecosystems to continue providing services such as food supply, flood regulation, and water purification.

Provisioning services

- Food (including seafood and game), crops, wild foods, and spices
- Raw materials (including lumber, skins, fuel wood, organic matter, fodder, and fertilizer)
- Genetic resources (including crop improvement genes, and health care)
- Medicinal resources (including pharmaceuticals, chemical models, and test and assay organisms)
- Energy (hydropower, biomass fuels)
- Ornamental resources (including fashion, handicraft, jewelry, pets, worship, decoration and souvenirs like furs, feathers, ivory, orchids, butterflies, aquarium fish, shells, etc.)

Regulating services

- Carbon sequestration and climate regulation
- Predation regulates prey populations
- Waste decomposition and detoxification
- Purification of water and air
- Pest and disease control

Cultural services

- Cultural (including use of nature as motif in books, film, painting, folklore, national symbols, architect, advertising, etc.)
- Spiritual and historical (including use of nature for religious or heritage value or natural)
- Recreational experiences (including ecotourism, outdoor sports, and recreation)
- Science and education (including use of natural systems for school excursions, and scientific discovery)

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- Science and education (including use of natural systems for school excursions, and scientific discovery)
- Therapeutic (including Eco therapy, social forestry and animal assisted therapy).

Soil Science through the eyes of Artificial intelligence

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"It is the little details that matter. Little things make big things happen", - John Wooden. In agriculture, smaller details encourage large-scale changes. To grow crops efficiently and sustainably, there are small, but fundamental details that need attention before we can focus on bigger issues like ecological imbalance or global food security. As it's said if roots of revolution are strong, the outcome has a stronger impact. Modern artificial intelligence has gained omnipotence in agriculture and it's time we use it properly. By channeling the power of AI in the right direction, adversarial risk towards farming will become yesterday's news.

What are these small things of revolution?

If you have ever tried to grow your own flowers, vegetables, or fertilize your lawn, you have probably been advised to buy a fertilizer that contains a combination of three main macronutrients: nitrogen, phosphorus, and potassium (NPK, respectively). These three macronutrients are essential for biomass formation and are required by growing plants in large amounts.

But why is NPK important?

Nitrogen and phosphorus are the building blocks of genetic material and are used for protein synthesis and other plant metabolic processes. Potassium is essential for plant regulating processes such as photosynthesis, enzyme activation, and osmoregulation. Since growing plants take up NPK in such large quantities, these elements are therefore the most commonly listed ingredients in most fertilizers. Besides understanding the importance of these three macronutrients for plant or crop growth, it is also important to understand how to maintain the appropriate amount of NPK to sustain sufficient plant growth, without over fertilizing the soil.

Where does AI fit the bill?

Artificial intelligence is constantly challenging our traditional methods and is taking control over issues such as ecological imbalance and endangered global food security. It is replacing our age-old, time-consuming, and costly techniques with real-time analyses and predicting a better picture. To paint a picture of an AI-driven agriculture, we start with capturing multispectral images of the farm, at a regular interval, using drones or some kind of ground vehicle. From a decade of collected soil data, AI can analyze the vegetation index of the multispectral images taken. These data, when analyzed, provides growers with a better understanding of the present NPK values. This is where things get interesting; a precise decision about the sustainability of soil NPK requires more than just data. It requires three distinct categories of soil data: the past, present, and future. The history of the nutrient management can be used to predict the fertility of the soil. It then uses current crops to predict the NPK contents of the soil at the end of the crop cycle. Lastly, the future chronology of crops is another factor taken into consideration by AI to decide of the amount of NPK fertilizer required by the soil. The resulting decision can be more accurate to sustain the current batch of crops along with the future chronology. Not only does AI address the fertility of the soil, ecological balance of nature, and sustainable agriculture, but it creates a sensible chronology of crops, which can help with economic efficiency for the grower.

Revolution has already begun; AI is changing the world of agriculture. These small, yet powerful, aspects are the basics, and we must get them right. Once we are done with our roots, we can slowly, but effectively, improve our crop production, which will set our future goal of global food security and ecological balance. The question is 'are we ready to ditch our old practices and opt for AI'? Well, it's time we decide for ourselves, as this might be a potential solution to age-old problems in agriculture. So believe in what we call 'the future of agriculture', as sometimes believing in a vision is all it takes.

ENVIRONMENTAL SOIL QUALITY AND SOIL FERTILITY

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SOIL QUALITY

Soil quality is defined as the fitness of a specific kind of soil, to function within natural or managed ecosystem boundaries, to sustain plant and animal productivity, maintain and enhance water and air quality, support human health and habitation.

SOIL FERTILITY

Soil fertility is the potential of the earth or inhere, it capacity of the soil to supply plant nutrients in quantity, forms and proportion required for the growth and development of the crop.To be healthy, plants need a steady supply of nutrients from the soil.Required in relatively large quantities are macronutrients:

- Nitrogen (N)
- Phosphorus (P)
- Potassium (K)
- Sulphur (S)
- Calcium (Ca)
- Magnesium (Mg).

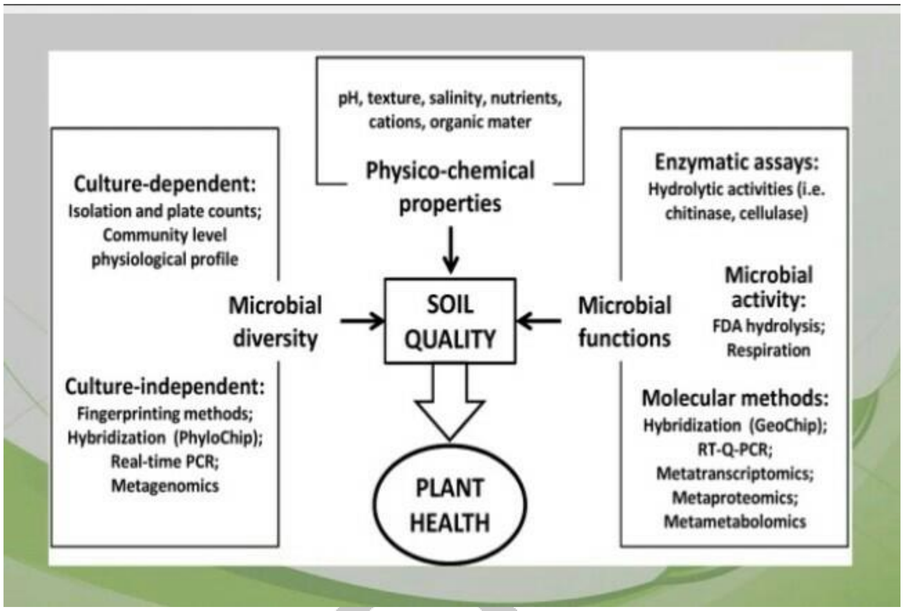
Other nutrients are required in small quantities. They are known as micronutrients or trace elements and include:

- Copper (Cu)
- Zinc (Zn)
- Iron (Fe)
- Manganese (Mn)
- Boron (B)
- Molybdenum (Mo)

A shortage or absence of any one of these essential nutrients can severely affect plant growth. Too much of any nutrient can also be as bad as too little.

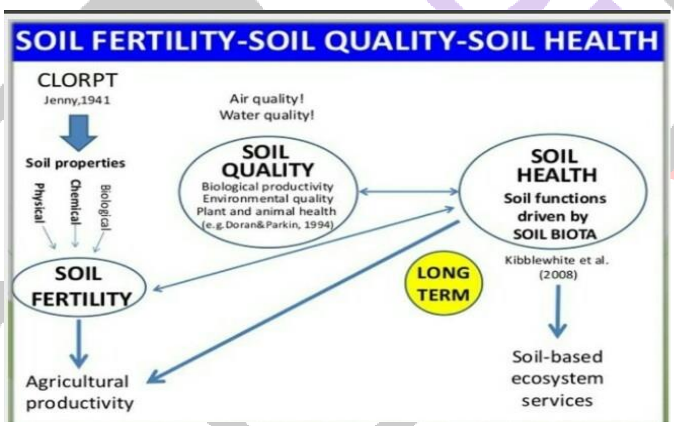
IMPORTANCE OF SOIL FERTILITY

- In all agricultural systems, significant quantities of nutrients are removed over time in harvested products.
- Off-site losses of nutrients can also occur through soil erosion, runoff, leaching and burning of crop residues.
- Gaseous losses of nitrogen may occur through denitrification and volatilisation.
- The usual management response to nutrient removal or loss is to apply fertiliser.
- When nutrient removal exceeds nutrient inputs, the soil's nutrient reserves are depleted and eventually crop yields decline.
- When nutrient inputs exceed crop demands, soil nutrient level increase. Off-site nutrient movement may occur, causing pollution of groundwater and surface water due to nitrogen and phosphorus being present in runoff and attached to sediments.



WAYS TO IMPROVE SOIL QUALITY

- Create permanent garden beds and pathways
- Choose not to till
- Create a new garden with sheet mulching
- Add organic matter
- Mulch for big benefits
- Plant cover crops
- Grow chop-and-drop nutrient accumulators



CONCLUSION

Maintenance and improvement of soil quality is one of the most important prerequisites to achieve the environmental sustainability. Soil quality indicators are valuable tools and are finding increasing application. However, dynamic soil indicators should be measured after estimation of inherent soil indicators.

SUSTAINABLE SOIL MANAGEMENT

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The whole agricultural productivity and our food security are mainly dependent on the health of soil. In fact, soil is the basis in providing our nutrients, water, climate, biodiversity and life. However, soils have been neglected at large. The damage caused by deforestation, extensive usage of synthetic fertilizers, mining, soil erosion, and rapidly growing urbanization are the major concerns. Because, all these soil destructing activities are not climate-neutral. Every year, the international community is observing December 5 as **'World Soil Day'** to connect people with soils and raise awareness on soils critical importance in our lives. The purpose is to highlight the importance of soil conservation, and a need to take up its preservation and restoration actions. Bearing in mind the sustainable development goals (SDGs), the role of soils health in enhancing agricultural productivity in a sustainable manner and its importance in global sustain-able development is also highlighted.

WHAT SHOULD BE DONE?

For sustainable soil management and agricultural sustainability, we need to promote eco-friendly practices to enhance the soil fertility and agricultural productivity). We also need to find out innovative ways of using eco-friendly agricultural practices. Innovative use of arbuscular mycorrhizal fungi, plant growth-promoting rhizobacteria (PGPR) and endophytes (fungal and bacterial) among communities not only to commemorate the 'World Soil Day' but also in everyday life, till the sustainability goal is achieved. All public and private institutions, universities, and departments those are associated with agriculture and sustainable development also need to promote awareness about the importance of sustainable soil management by highlighting the role of healthy soil for our wellbeing, and local, regional and global sustainable development.

"To forget how to dig the earth and to tend the soil is to forget ourselves"

SOIL DEGRADATION; A GLOBAL PROBLEM ENDANGERING SUSTAINABLE DEVELOPMENT

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Soil degradation, defined as lowering and losing of soil functions, is becoming more and more serious worldwide in recent decades, and poses a threat to agricultural production and terrestrial ecosystem. It is estimated that nearly 2 ***billion ha of soil resources in the world have been degraded, namely approximately*** 22% ***of the total cropland, pasture, forest, and woodland. Globally, soil erosion, chemical deterioration and physical degradation are the important parts amongst various types of soil degradation. As a natural process, soil degradation can be enhanced or dampened by a variety of human activities such as inappropriate agricultural management,overgrazing, deforestation, etc. Degraded soil means less food. As a result of soil degradation, it is estimated that about*** 11.9–13.4% ***of the global agricultural supply has been lost in the past five decades. Besides, soil degradation is also associated with off-site problems of sedimentation, climate change, watershed functions, and changes in natural habitats leading to loss of genetic stock and biodiversity. Therefore, it is essential to combat soil degradation at different levels and scales worldwide, not only for food security and ecological health, but also for the guarantee of global sustainable development.***

Soil Health

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Introduction:
Soil is the important basis for agriculture. Healthy soil can produce crops with more nutrients and it also improves the food quality. So, maintaining soil health is very important.

Description:
Soil Health is achieved by maintaining organic matter, which comes from dead and decayed plants and animals. Microorganisms help for plant growth, fixation of nutrients and gases in soil. So it improves the soil fertility and it also stores the various gases in soil. In order to maintain soil health we should decrease the use of synthetic fertilizers. Minimum tillage, with protective crop cover and crop rotations are practiced. In this way we can maintain Soil Health.

Conclusion:
Soil has both Environmental impact and nutritional impact on human beings, as we are consuming food that comes from soil.
A Healthy soil makes the life of a human healthier.

Soil Temperature

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SOIL TEMPERATURE;

Heat is a form of energy and temperature is a measure of the heat energy. The heat energy refers to kinetic energy or random motion (vibration) of molecules of a substance. The speed of vibration is directly proportional to temperature.

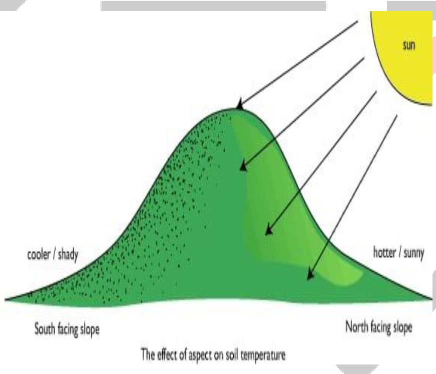
Soil temperature is an important plant growth factor like air, water and nutrients. Soil temperature affects plant growth directly and also indirectly by influencing moisture, aeration, structure, microbial and enzyme activities, rate of organic matter decomposition, nutrient availability and other soil chemical reactions. Specific crops are adapted to specific soil temperatures. Apple grows well when the soil temperature is about 18^0C, maize 25^0C, potato 16^0C to 21^0C, and so on.

SOURCE OF SOIL HEAT

1. The sources of heat for soil are solar radiation (external), heat released during microbial decomposition of organic matter and respiration by soil organisms including plants and the internal source of heat is the interior of the Earth - which is negligible.
2. The rate of solar radiation reaching the earth's atmosphere is called as solar constant and has a value of 2 cal cm-2 min-1.
3. Major part of this energy is absorbed in the atmosphere, absorbed by plants and also scattered. Only a small part of it reaches soil.
4. Thermal energy is transmitted in the form of thermal infrared radiation from the sun across the space and through the atmosphere.

Effect of soil temperature on plant growth

1. The soil temperature requirement of plants varies with the species.
2. The temperature at which a plant thrives and produces best growth is called optimum range temperature,
3. The entire range of temperature under which a plant can grow including the optimum range is called growth range.
4. The maximum and minimum temperatures beyond which the plant will die are called survival limits.



SOIL FERTILITY

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"Fertility of the soil is the future of civilization"

Land degradation and desertification threaten the fertile land. On a global scale, 10-20% of the dry land sand 24% of the world's productive lands is degraded.

"Soil fertility refers to the ability of the soil to sustain plant growth by providing essential plant nutrients".

Usually, a fertile soil is rich in nutrients, has good aeration, water holding capacity, good texture and pH range of 5.5 to 7. Earthworms and microorganisms are very important in the development of fertile soil.

It is crucial for agricultural productivity. We can improve by soil nutrient management; minimizing nutrients depletion by using the techniques can reduce the negative impacts on the environment.

"To feed our people we must first feed our soil".

Soil

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Soil, the requisite element of our environment, which is also the integument of the earth, is the residing spot of millions of microorganisms. The benefits of soil for all living creatures are phenomenal and beyond your knowledge.

Life on the Earth is merely not possible without soil. It permits plants to grow and ensures that you get enough oxygen for survival. Yes, as we all know, trees provide oxygen, and the soil is the medium for a plant or a tree to grow healthier. Further, soil holds and cleans water.

Ultimately, you can enjoy clean, drinkable, and pure groundwater. And, it recycles nutrients and provides a home for a plenitude of organisms on Earth, comprising of different organisms starting from nano-sized to macro-sized species. Except for hydroponics, it is unable to grow and cultivate other plants without soil. Mesophytic and Xerophytic plants need soil to grow favorably. Moreover, some of the semi-hydrophytic plants also root into the soil for its betterment in growth.

Earthworms, the farmer's friend resides on the soil. It nourishes the soil and builds the quality of the same. Sadly, we humans aren't aware of the eternal gains of soil and keep dissipating it for no reason. Are you conscious of the fact that it can take up to 1000 years to form 1 cm of soil? If not, hear now! This is the right time to protect the beneficial resources of Earth. If not now, then never!

SOIL EROSION

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Erosion derived from latin word 'erodere' meaning – to eat away or to excavate. All over the world, wherever human being started the agricultural operations there exists the problem of soil erosion. The loss of natural vegetation, excessive grazing results in severe erosion problems.

Soil is the upper most layer of earth and it consists of weathered and disintegrated minerals mixed with organic substances. The depth of soil varies from place to place however the top 30 cm soil depth is very useful both for human and animal life. This thin layer is largely responsible for both the physical support and the nutrition of plant growth. This top layer is continuously exposed to the actions of atmospheric activities. The water and wind are the two main active forces which always tend to dislodge the top soil layer and transport them from one place to another.

Soil erosion is a three phase phenomena consisting the detachment of soil particles from the soil mass and their transport by erosion agents like water and wind. When sufficient energy is no longer available with the erosive agents to transport the particles, then the third phase called deposition takes place

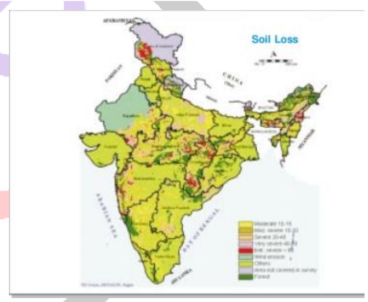
Erosion may be broadly classified into two groups.

1. **Geological erosion** -This is also known as natural or normal erosion. It is the erosion of soil in its natural condition without the influence of human being. It takes place on a result of water, wind, gravity and glaciers.

2. **Accelerated erosion** -It is activated by natural and man's activities which brought changes is natural cover and soil conditions. When the vegetation is removed and land is put under cultivation, this is known as accelerated erosion or abnormal erosion.

The main factors responsible for soil erosion in India

1. Excessive deforestation.
2. Over grazing
3. Faulty agricultural practices.



Problems caused by erosion

1. Damage to sea coast and formation of sand dunes.
2. Diseases and public health hazards.
3. Spent of money on water purification works.
4. Siltation of irrigation channels and reservoirs
5. Silting of rivers.

The main principles to control erosion are to:

1. Use land according to its capability.
2. Protect the soil surface with some form of cover.
3. Control runoff before it develops into an erosive force.

HEALTHY SOILS FOR HEALTHY LIFE

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Every year 5^{th} of December is celebrated as the World Soil Day across the globe to highlight. The importance of soil health for the well-being of living organisms on the earth. The International Union of Soil Sciences in 2002 adopted is solution proposing the 5^{th} of December as World Soil Day to celebrate the importance of soil a critical component of the natural system and as a vital Contributor to the human well-being. It was firstly celebrated on December5, 2012, which Corresponds with the birthday of Thai King Bhumibol Adulyadej, who officially sanctioned the event. This day is a global observance. Soil provides living space for the living organisms as well as the ecosystem services which are essential for the water regulation, biodiversity conservation, carbon sequestration etc. In fact, the soil is under tremendous pressure due to increase in population atan alarming rate and higher demand for food.

Problems like deforestation, bad agricultural practices and pollution have degraded soil. It has been observed that around 33 percent of global soils are degraded. Soil is constituted of organic remains, clay and rock particles found on the earth's surface. Soil helps in food production, biodiversity and energy maintenance. Soil health is being deteriorated by the unhealthy agricultural practices, deforestation and pollution.

Healthy soil is the key to sustaining life and the adoption of sustainable land management Practices are becoming more and more important. Increase in the soil carbon builds a precious Reservoir and helps to offset greenhouse gas emissions. It also contributes in the fertility of the Soil, the foundation for all land-based natural and agricultural ecosystems which provide a major Part of the world's food supply, natural resources and biodiversity.

More than 10 million people have abandoned their home lands because of environmental issues including drought, soil erosion, desertification and deforestation. Soil improves our resilience to floods and droughts. Majority of the known antibiotics Originated from soil bacteria including penicillin. There is urgent need to create awareness among the farmers on soil health and technical and scientific advice should be provided to them.

SOIL BIODIVERSITY

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"Without soil and their biodiversity, there is no human life."

Introduction
Soil biodiversity refers to all living organisms in the soil. A teaspoon of topsoil typically contains a vast range of different species and up to 6 billion microorganisms.

Why soil biodiversity is important?
Are essential for the cycling of ecosystem nutrients, and are necessary for plant growth and plant nutrition. The maintenance of soil biodiversity is essential to both the environment and to agricultural industries.

Ways to control biodiversity:

- Cropping system design and genetic control of soil function and soil fertility management using rhizobia, diazotrophs, etc.

Conclusion:
Soil bacterial communities exhibited compositional shifts that tracked with charges in land use and soil management. Soils subjected to low human inputs showed a more stable bacterial community than those with high human input.
"I can't imagine anything more important than air; water, soil, and energy and biodiversity .These are the things that keep us alive."

SOIL FERTILITY MANAGEMENT

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The pressures of constantly increasing agricultural production have in turn resulted in a persistent decline in soil fertility. This could possibly be a major challenge that Indian agriculture is currently facing. The demand for food grain is expected to increase, but with the current soil health status, meeting the targets would be a huge challenge. Soil fertility and nutrient management is one of the important factors that have a direct impact on crop yield and quality. Irrespective of the size of your field or plot, supplying plants with the right amount of nutrients at the right time is the key to a successful production enterprise.

Soil fertility is a concept based on the amounts of essential nutrients available to the plants. The plant nutrients involved are classified as macronutrients such as nitrogen (N.), phosphorous (P), potassium (K), calcium (Ca), magnesium (Mg), and sulfur (S); or as micronutrients such as iron (Fe), manganese (Mn), copper (Cu), zinc (Zn), boron (B), and molybdenum (Mb). The amount of each of these nutrients is not the only factor in determining whether there are nutrient shortages. Soil pH (acidity) is also important because under certain pH conditions, nutrients form insoluble compounds which are unavailable to be taken up by plant roots.

Ways of depleting soil fertility

- Leaching
- Soil erosion
- Continuous cropping
- Accumulation of salts

What to be done: This can be enhanced through organic and inorganic fertilizers to the soil. Soil fertility management practices include the use of fertilizers, organic inputs, crop rotation with legumes and the use of improved germplasm. Reduce Pesticide Use and Provide Habitat for Beneficial Organisms.

Healthy soil is the foundation for profitable, productive, and environmentally sounds agricultural systems

Soil

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Soil is a mixture of organic matter, minerals, gases, liquids and organisms that together support life. Earth's body of soil called the PEDOSPHERE.

Soil is the natural resource at the surface of Earth crust where climate (atmosphere) and life (biosphere) meet. Soils consist mainly of particles of minerals and rocks, and organic matter.

IMPORTANT:

Soil is our life support system. Soils provide anchorage for roots, hold water and nutrients. Soils are home to myriad microorganisms that fix nitrogen and decompose organic matter and armies of microscopic animals as well as earthworms and termites. We build on soil as well as with it and in it.

FORM:

Soil are not stable, they continue to change over time. We say that soils go through development phases. Some soils may be considered "young" and other soils may be regarded "old".

SOIL AERATION

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WHAT IS SOIL AERATION

Soil aeration is defined as the exchange of gases between the soil and the atmosphere. Since plant roots and soil microorganisms absorb O2 and release CO2 during aerobic respiration in the soil profile, soil aeration is one of the most important determinants of soil productivity

Causes of Poor Aeration:

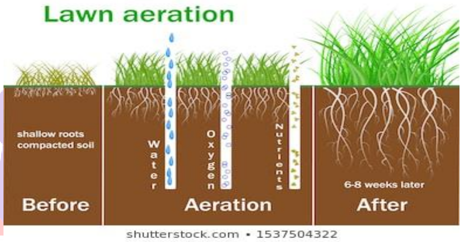
Compact soils of finer textures suffer from poor aeration. Cultivation (working-the soil when crops are growing) of soil prevents it. Water logging is another important cause of poor aeration especially in the case of soils of finer texture.

Mechanism of Gaseous exchange

(i) Mass flow:

Gases may move in a mass in the soil or out of it. When the atmospheric pressure is increased, volumes of gases present in the soil are decreased and therefore atmospheric gases enter the soil. Rain water displaces soil gases in the pore space and also carries gases dissolved in it to the soil. Rain fall usually account for 1/12 to 1/16th of the normal soil aeration. Variations in temperature and pressure between the soil and at the atmosphere play an insignificant role in soil aeration.

(ii) Diffusion:



Most of the gaseous interchange between the soil and the atmosphere takes place by diffusion. Diffusion is the process by which each gas tends to move in the space occupied by another as determined by the partial pressure of each gas. The partial pressure of a gas is the pressure which the gas would exert if it were present alone in the volume which has been occupied by the mixture of gases.

Aeration status of soils

(i) Percentage oxygen and carbon dioxide content of the soil,
(ii) Oxygen diffusion rate, and
(iii) The oxidation reduction potential (Redox potential).

"SOIL IS THE BASIS OF LIFE"

Keep Soil Alive Protect Soil Biodiversity

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World Soil Day 2020 and its theme "Keep soil alive, Protect soil biodiversity" aims to arise awareness of the importance of maintaining healthy ecosystems and human well-being by addressing the growing challenges in soil management, fighting soil biodiversity loss, increasing Soil awareness and encouraging government, communities and individuals around the world to Commit proactively improving the soil health.

When we go about our daily routines, most of us are unaware that beneath our feet lies an
Outstandingly diverse community of plants, animals and microbes that make up our soils. Soils are more than just “dirt”-they’re a major reservoir of global biodiversity, supporting agriculture and food security, regulating green house gas emissions and promoting plant, animal and human health. Without them our world wouldn’t be the same.

Soil Biodiversity is the foundation for human life. We can all play a role and protect soil
Biodiversity by raising awareness and advocating for soil biodiversity education, managing soil Resources sustainably, supporting soil biodiversity and sustainability research, investing in Innovation and reducing, reusing and recycling materials before sending them to a land fill. Insignificant contrast too there environmental compartments (air, water systems) human took possession of soil from early times. The concept of "owned soil" underlines this fact. Soil therefore represents the most important resources for human life in both its material and cultural aspects. It’s alive! Soil is much more than we think. Soil is not just four letter words (SUSTAINABLE ORGANIC INTEGRATED LIVELIHOOD) it’s our life and it makes us to think that every living creatures from small microbes to big creatures need sit. We’ve taken soil for granted as long enough.

Let’s keep soil alive and protect soil biodiversity!

Soil Profile

Mr.A.Arunarasan,

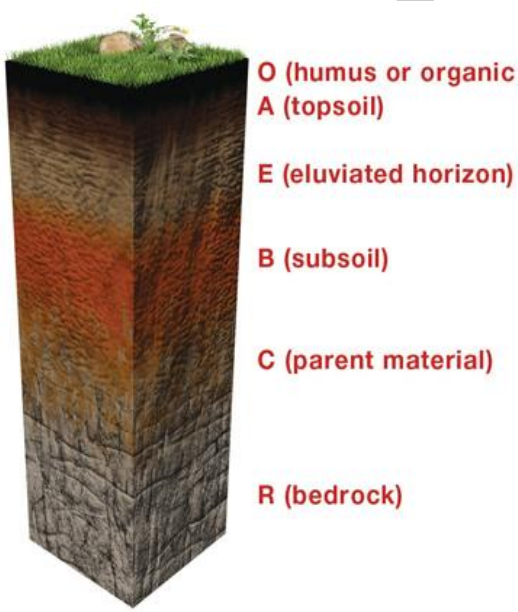
III B.Sc, (Hons.) Agriculture,
Palar Agricultural College

Introduction:

There are different types of soil, each with its own set of characteristics. Dig down deep into any soil, and you'll see that it is made of layers, or horizons (O, A, E, B, C, R). Put the horizons together, and they form a soil profile. Like a biography, each profile tells a story about the life of a soil. Most soils have three major horizons (A, B, C) and some have an organic horizon (O).

The horizons are:

O – (humus or organic) Mostly organic matter such as decomposing leaves. The O horizon is thin in some soils, thick in others, and not present at all in others.
A - (topsoil) Mostly minerals from parent material with organic matter incorporated. A good material for plants and other organisms to live.
E – (Eluviated) Leached of clay, minerals, and organic matter, leaving a concentration of sand and silt particles of quartz or other resistant materials – missing in some soils but often found in older soils and forest soils.
B – (subsoil) Rich in minerals that leached (moved down) from the A or E horizons and accumulated here.
C – (Parent material) the deposit at Earth's surface from which the soil developed.
R – (bedrock) A mass of rock such as granite, basalt, quartzite, limestone or sandstone that forms the parent material for some soils – if the bedrock is close enough to the surface to weather. This is not soil and is located under the C horizon.



Conclusion

The soil profile is an important tool in nutrient management. By examining a soil profile, we can gain valuable insight into soil fertility.A highly fertile soil often has a deep surface layer that contains high amounts of organic matter. With clues provided by soil profile, we can begin to predict how a soil will perform under certain nutrient management conditions. A study of the soil profile is important from crop husbandry point of view, since it reveals the surface and the subsurface characteristics and qualities, namely depth, texture, structure, drainage conditions and soil-moisture relationships, which directly affect plant growth.

SOIL HEALTH

Mr.P.KAMLESHWARAN,

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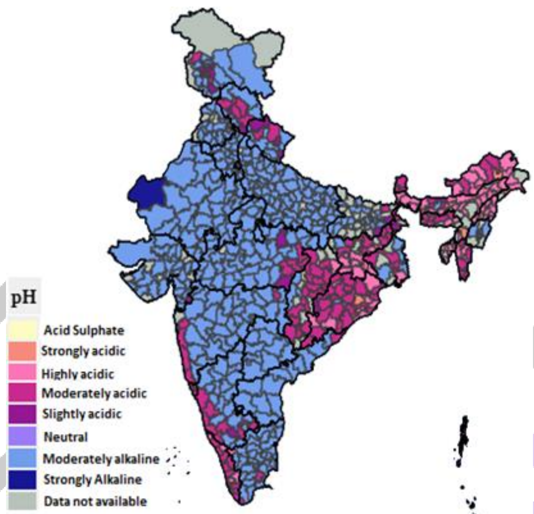
Now a days, we know that our health is in impact ,if we have to improve our health then we need to improve the health of soil .Then What is Soil health, it also referred to as soil quality, is defined as the continued capacity of soil to function as a vital living ecosystem that sustains plants, animals, and humans. This definition speaks to the importance of managing soils so they are sustainable for future generations. To do this, we need to remember that soil contains living organisms that when provided the basic necessities of life - food, shelter, and water - perform functions required to produce food and fiber.



What does the Healthy soil gives us; clean air and water, bountiful crops and forests, productive grazing lands, diverse wildlife, and beautiful landscapes. Soil does all this by performing five essential functions:

- Regulating water
- Sustaining plant and animal life
- Filtering and buffering potential pollutant
- Cycling nutrients
- Physical stability and support

Inherent and Dynamic Properties of Soil

Inherent soil quality is a soil's natural ability to function. For example, sandy soil drains faster than clayey soil. Deep soil has more room for roots than soils with bedrock near the surface. These characteristics do not change easily.

Dynamic soil quality is how soil changes depending on how it is managed. Management choices affect the amount of soil organic matter, soil structure, soil depth, and water and nutrient holding capacity. Soils respond differently to management depending on the inherent properties of the soil and the surrounding landscape.

SOIL HEALTH MANAGEMENT PRACTICES; Reduce inversion tillage and soil traffic, Increase organic matter inputs and use cover crops Reduce pesticides use and provide habitat for beneficial organisms, rotate crops and manage nutrients. By improving the soil health we can improve the health of people and we can provide a good and secure environment for our future generation

"HEALTH OF SOIL IS WEALTH OF NATION"

Soil Profile

Mr.A.Arunarasan,

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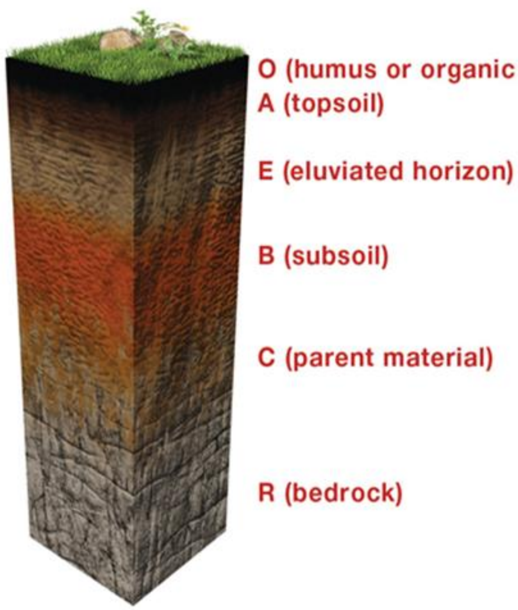

Conclusion

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SOIL TYPES IN KANYAKUMARI DISTRICT

Ms.V.Adlin Jemima,

III B.Sc.(Hons.) Agriculture,
Palar Agricultural College

In this abstract I discussed about the types of soils in Kanyakumari District. There are four types of soils in Kanyakumari District. They are i) Red Soil, ii) Red lateritic soil, (iii) Brown soil and iv) Coastal sand. The soils are mostly in-situ in nature, lateritic, earthy and pale reddish in colour. They are derived from laterisation of gneisses. The soils derived from gneisses are mostly brownish. The thickness of soils in the mounts is almost negligible whereas in the valleys it is around 2 m.

The study area Kanyakumari District is in the southern part of Tamil Nadu which is situated in at the foot of the Western Ghats and bounded by Tirunelveli district in the north and north east, by Kerala state in the north west, Bay of Bengal in the south east, Indian Ocean in the south and the Arabian sea in the west. The district is with an area of 1684 km2 and it lies between 77.05o and 77.360 of the eastern longitude and 8.03 o and 8.35 o of the northern latitude.

I visited and survey the soil types of some blocks. The lateritic type of soil occurs in Thiruvattar, Munchirai, Maruthancode, Rajakkam angalam, Killiyur, Thuckalay and Melpuram blocks. The mixed type of Red and alluvial soils, occur in Agastheeswaram and Thovalai blocks. The coastal sand is occurs in the Western side of the district. The coastal alluvium sand is of high fertility. Soil in the district is mostly of the red loam variety. In the seacoasts, however, the sandy type of soil prevails and gravel soil is seen in the mountain regions. In the low lands there is neither white sand or sandy loam while in the midlands and high lands there prevails fairly fertile soil of fine type particularly in the valleys.

Keywords: alluvial, laterisation and prevails.

SOILS OF TAMIL NADU

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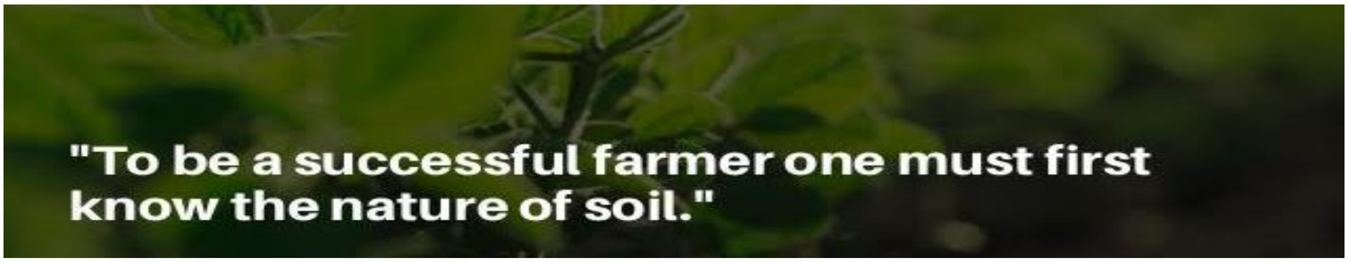
Soil is one of the most important non-renewable basic resources on the earth's surface. First of all we want to know about the types of soil present in our state. It is necessary to know the types of soil for planning of cropping system, need of pulse intercropping, croppingpattern and also in the reclamation of the soil etc..

Major soil groups of Tamil Nadu are:



1. Red soils, (62 per cent) 2.Black soils (12 per cent) 3.Laterite soils (3 per cent) 4.Coastal soils (7 per cent)T**he red soils are further classified as;1.**Red loamy (30 per cent ,2.Red sterile (6 per cent) ,3.Red-sandy (6 per cent),4.Thin red (2 per cent) and,5.Deep red long(8%).

Classification of Tamil Nadu Soils:

1. **Red loam:** Pats of Kancheepuram, Cuddalore, Salem, Dharmapuri, Coimbatore, Tiruchirappalli, Thanjavur, Ramanathapuram, Madurai, Tirunelveli, Sivagangai, Thoothukudi, Virudhunagar, Dindigul and Nilgiris districts.
2. **Laterite soil:** Parts of Nilgiris district.
3. **Black soil:** Parts of Kancheepuram, Cuddalore, Vellore, Tiruvannamalai, Salem, Dharmapuri, Madurai, Ramanathapuram, Tirunelveli, Sivagangai, Thoothukudi, Virudhunagar, Dindigul and Nilgiris districts.
4. **Sandy coastal alluvial soil:** Along the coasts in Ramanathapuram, Thanjavur, Nagapattinam, Cuddalore, Tiruvarur, Kancheepuram and Kanniyakumari districts.
5. **Red sandy soils:** Small patches in Coimbatore and Nilgiris districts.
6. **Riverine alluvial soils:** Parts of Kancheepuram, Tiruvallur, Villupuram, Cuddalore, Thanjavur, Nagapattinam, Tiruvarur, Ramanathapuram and**Thoothukudi**

- **As per the USDA system of soil classification (Taxonomy), the soils of Tamil Nadu are classified Six:**
- **1.Entisols(6%), 2.Inceptisols(50%), 3.Vertisols(7%), 4.Ultisols(1%), 5.Alfisols(30%), 6.Mollisols(very negligible area).**

Soil alive

Mr.K.Nagavenkatasai,

II. B.Sc, (Hons.) Agriculture,
Palar Agricultural College

Introduction

The biological agents or chemical acids or organic materials makes soil alive and increases its fertiiity status . Lets discuss above factors in detail:

Biological factors/ agents/ orgamisms.

Plant roots can penetrate into crevices to produce more fragmentation. Plant secretions promote the development of microorganisms around the root in an area known as the rhizosphere. Additionally, leaves and other material that fall from plants decomposes and contribute to soil composition.

Living organisms present in soil include archaea, bacteria, actinomycetes, fungi, algae, protozoa, and a wide variety of larger soil fauna, including springtails, mites, nematodes, earthworms, ants, insects that spend all or part of their life underground, and larger organisms such as burrowing rodents. Cow dung enhances the fertility of soil by the help of methanogenic bacteria and it also produces biogas in to atmosphere. Example; cultivation of black gram or soyabean enhances nitrogen content in soil.

Earthworms

By their activity in the soil, earthworms offer many benefits; increased nutrient availability, better drainage, and a more stable soil structure, all of which help improve farm productivity. Worms feed on plant debris (dead roots, leaves, grasses, manure) and soil. Nitrogen in the casts is readily available to plants. Earthworms will make soil porous, so that the roots can easily penetrate into the soil.

Microorganisms

Soil microorganisms are responsible for most of the nutrient release from organic matter. When microorganisms decompose organic matter, they use the carbon and nutrients in the organic matter for their own growth. They release excess nutrients in to the soil where they can be taken upo by plants. Microorganisms play foremost role in soil formation and soil ecology because they as ' natural soil engineers' regulatethe flux of nutrients to plants and prop up nitrogen fixation, and ultimately promote detoxification of naturally occuring inorganic and organic pollutants in soil.

One of the most important roles of soil organisms is breaking up the complex substances in decaying plants and animals so that they can be used again by living plants. This involves soil organisms as catysts in a numer of natural cycles, among the most prominent being the carbon, nitrogen and sulfur cycles.

Role of organic matter in soil fertility

Organic matter forms a very small but an important portion and it is obtained from dead plant roots, crop residues, various organic manures like farm yard manure, compost and green manure, fungi, bacteria, worms and insects.

It is matter composed of organic compounds that have come from the remains of organisms such as plants and animals and their waste products in the environment. Organic molecules can also be made by chemical reactions that don't involve life. Adding compost increases the nutrient holding and water holding capacity of your soil. Organic matter improves soil porosity, providing spaces for roots to grow. It alsoprovides a home for the wealth of living creatures present in your soil. These creatures help convert the nurients in the soil into forms that plants can use. Make them welcome in your soil by providing space for them to live and your plants will benefit.

Functions of organic matter

- Organic matter improves the physical condition of the soil, particularly the structure.
- Decaying organic matter acts as a food material for bacteria, fungi and other organisms
- Presence of organic matter dissolves many insoluble soil minerals and make them available to plants
- It plays an important role in the nutrient supplying power of soil as it has got high cation exchange capacity (CEC)
- It increases the water holding capacity of the soil, particularly in sandy soils.
- It improves aeration and infiltration in heavy soils.
- It reduces loss of soil by water and wind erosion
- It regulate soil temperature

- It serves as an important source of certain plant of food element (N,P,S etc)

The buffering nature of the organic matter is considered to be advantageous in the residue management of pesticides, herbicide and other heavy metals.

Role of organic/ chemical acids in making soil fertility

Plant roots can exude organic acids such as malic and citric acids into the rhizosphere which effectively reduced rhizophere pH and solubilize P bound in soil minerals. Plants also liberate PO43- from organic sources byreleasing enzymes such as acid phosphatases. Soil organic acids (OAs) are a significant part of the water – soluble fractions of organuc molecules released in the rhizosphere. They are normal constituents of most agricultural soils and play important roles in soil nutrient availability, ecology and productivity. They are insoluble in water. Increases soil fertility by exhibiting acidic or basic characters. Examples; Succinic acid is found in many plants, and glutaric and adipic have been isolated from the suar beet. Mlic acid is found as the free acid and as the salts of malic acid in many plants, and particularly in tomatoes and it is found in smaller quantities in other foods.

Conclusion

However to make a soil fertile and alive we should not use chmical fertilizers, use only biofertilizers so that they can increase the microbial population in soil. Plants should not be removed. So they increase soil fertility by its secretions. We should burry the dead organic matter of plants and animals. So that the soil becomes fertile forever.

Organic fertilizer vs. Chemical fertilizer and their impact on land

Ms. Kaviya

II B.Sc.(Hons.) Agriculture,
Palar Agricultural College

I am willing u to grab ur attention towards organic fertilizer vs. Chemical fertilizer and their impact on land , we all have an idea about organic fertilizers (Organic fertilizers are fertilizers derived from animal matter, animal excreta (manure), human excreta, and vegetable matter (e.g. compost and crop residues). Naturally occurring organic fertilizers include animal wastes from meat processing, peat, manure, slurry, and guano).

Now what role to they play in land, However, organic fertilizer has multiple benefits due to the balanced supply of nutrients, including micronutrients, increased soil nutrient availability due to increased soil microbial activity, the decomposition of harmful elements, soil structure improvements and root development, and increased soil water availability. But still we have some draw backs are; the biggest disadvantage of using an organic fertilizer is that it may not contain primary nutrients like nitrogen, phosphorous or potassium, also known as NPK. Manure-based fertilizers contain these nutrients and are still considered organic. However, many others don't contain significant quantities of NPK.

Chemical fertilizers are the familiar term as everyone knows. The term “chemical fertilizer” refers to any number of synthetic compound substances created specifically to increase crop yield. Some chemical fertilizers, for example, are “nitrogenous” — containing nitrogen — while others are phosphate-based. Other fertilizers are potassium. Chemical fertilizer (consumption increased exponentially throughout the world, causes serious environmental problems. Fertilization may affect the accumulation of heavy metals in soil and plant system. Plants absorb the fertilizers through the soil, they can enter the food chain).but still ,they affect the land by though chemical fertilizers increase crop production; their overuse has hardened the soil, decreased fertility, strengthened pesticides, polluted air and water, and released greenhouse gases, thereby bringing hazards to human health and environment as well.

To be noted:

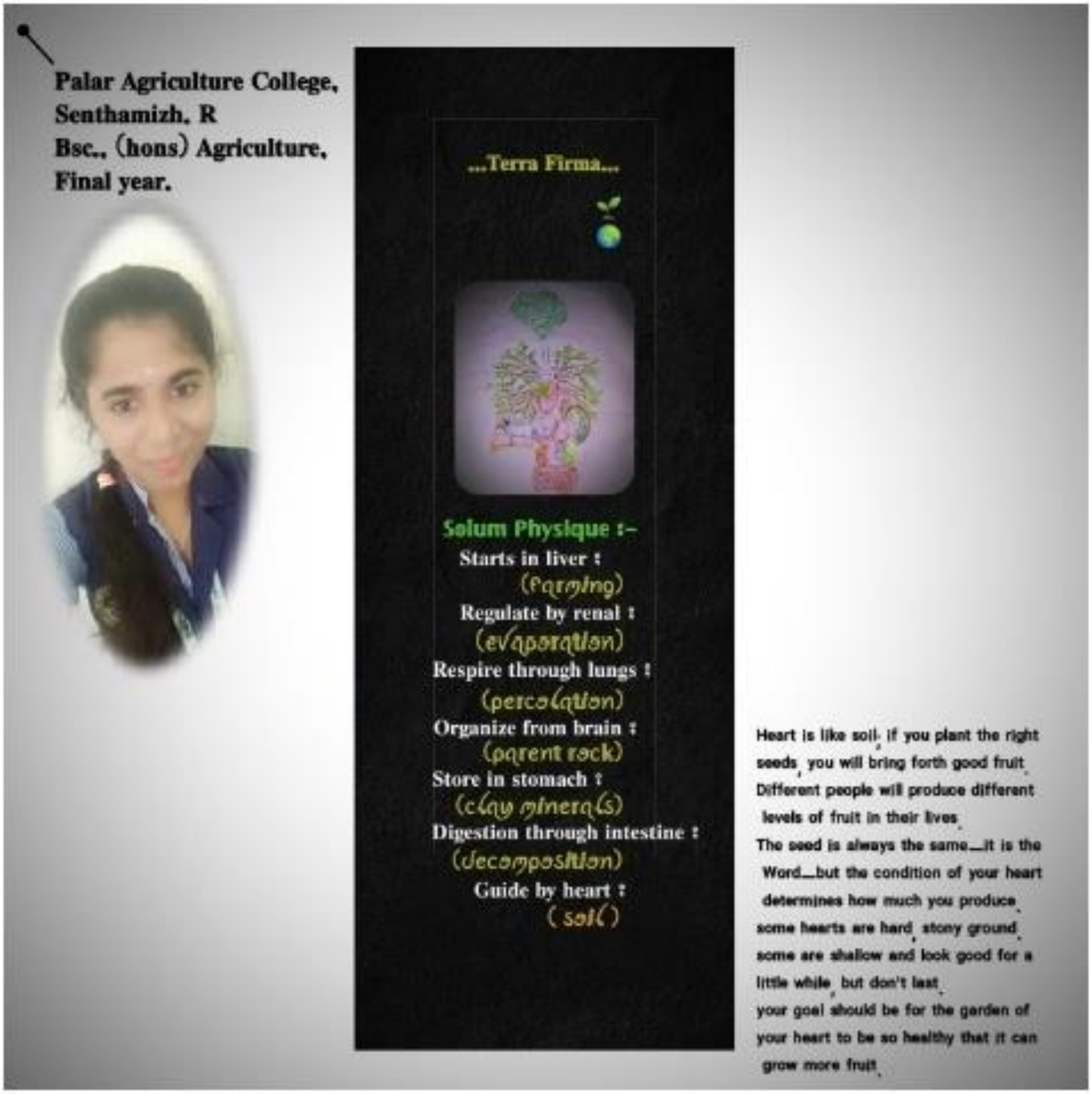
Integrated nutrient management (INM) is a scheme that refers to a safest way to dispose of crop residues and produce high-quality compost by a balanced and integrated use of both sources of fertilizers together in combinations (organic and inorganic fertilizers) for maintaining soil fertility. So friends you would have clearly understood about the impact of fertilizer on land. so, it's insisted to use less quantity of fertilizer and cultivate the crop in better way.

PAC AGRIANS CONTRIBUTIONS

POSTERS

TERRA FIRMA

Ms. R.SENTHAMIZH, Final year, B.Sc,(Hons.) Agriculture, Palar Agricultural College



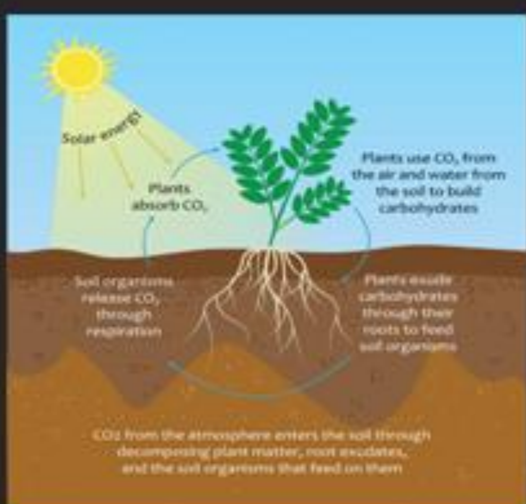
SOIL CARBON SEQUESTRATION

Ms. R.ASWINI,B.Sc, (Hons.) Agriculture, Palar Agricultural College

SOIL CARBON SEQUESTRATION

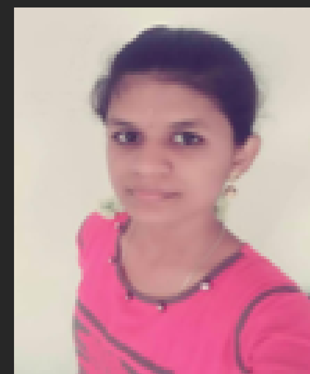
Ms. R.Aswini, Final Year, B.Sc,(Hons.) Agriculture, Palar Agricultural College

Recently, the contributions of the soil in various ecosystems have become more prominent with the recognition of its role as a carbon sink and the potential of that in reducing the concentration of carbon dioxide (CO2), which is a vital greenhouse gas, from the atmosphere. Conversely, the soil capacity to increase the concentration of CO2 in the atmosphere through mineralization of organic matter is also a source of concern. Mineralization of only 10% of the soil organic carbon pool globally is believed to be equivalent to about 30 years of anthropogenic emissions. This underscores the need to preventing carbon loss (emission) from the soil resource. Globally, the soil contains a large carbon pool estimated at approximately 1500Gt of organic carbon in the first one meter of the soil profile. This is much higher than the 560 Gt of carbon (C) found in the biotic pool and twice more than atmospheric CO2. By holding this huge carbon stock, the soil is preventing carbon dioxide build up in the atmosphere which will confound the problem of climate change. There are a lot of strategies used in sequestering carbon in different soils; however, many challenges are being encountered in making them cost effective and widely acceptable.



BENEFITS OF VOLCANIC ERUPTIONS IN SOILS

Ms.V.GAYATHRI, Final Year, B.Sc, (Hons.) Agricultural College



BENEFITS OF VOLCANIC ERUPTION IN SOILS

V. GAYATHRI, B.Sc, (Hons.) Agriculture, Palar Agricultural College

Volcanic eruptions result in ash being dispersed over wide areas around the eruption site. And depending on the chemistry of the magma from which it erupted, this ash will be containing varying amounts of soil nutrients. While the most abundant elements in magma are silica and oxygen, eruptions also result in the release of water, carbon dioxide (CO^2), sulfur dioxide (SO^2), hydrogen sulphide (H^2S), and hydrogen chloride (HCl), amongst others.

In addition, eruptions release bits of rock such as pot olivine, pyroxene, amphibole, and feldspar, which are in turn rich in iron, magnesium, and potassium. As a result, regions that have large deposits of volcanic soil (i.e. mountain slopes and valleys near eruption sites) are quite fertile. For example, most of Italy has poor soils that consist of limestone rock. But in the regions around Naples (the site of Mt. Vesuvius), there are fertile stretches of land that were created by volcanic eruptions that took place 35,000 and 12,000 years ago. The soil in this region is rich because volcanic eruption deposits the necessary minerals, which are then weathered and broken down by rain. Once absorbed into the soil, they become a steady supply of nutrients for plant life. Hawaii is another location where volcanism led to rich soil, which in turn allowed for the emergence of thriving agricultural communities. Between the 15th and 18th centuries on the islands of Kauai, O'ahu and Molokai, the cultivation of crops like taros and sweet potatoes allowed for the rise of powerful chiefdoms and the flowering of the culture we associate with Hawaii today.

EXPLORE SOIL EROSION AND HOW PLANTS PURIFY OUR WATER

Ms.N.MONISHA, B.Sc, (Hons.) Agriuclture. Palar Agricultural College

KEEP SOIL ALIVE PROTECT BIODIVERSITY

Ms.I.PRAVEENA, B.Sc, (Hons.) agriculture, Palar Agricultural College

KEEP SOIL ALIVE, PROTECT SOIL BIODIVERSITY

Ms. I. Praveena, first year, B.Sc. (Hons.) Agriculture

Palar agricultural College

Plants nurture a whole world of creature in the soil, that in return feed and protect the plants. This diverse community of living organisms keeps the soil healthy and fertile .the increase in challenges of soil management this year the FAO campaign keep soil alive , protect soil biodiversity of sustaining healthy ecosystems and human well being.

World soil day (WSD) is held annually on 5th December as a means to focus attention on the importance of healthy soil and to advocate for the sustainable management of soil resources .

An international day is to celebrate soil was recommended by the INTERNATIONAL UNION OF SOIL SCIENCES (IUSS) in 2002.under the leadership of the kingdom of Thailand.

The FAO conference unanimously endorsed world soil day in june 2013 and requested its official adoption at the 68th un general assembly . In December 2013 , the UN general assembly responded by designating 5th December 2014 as the 1st official world soil day.

Why 5th December?

The date of 5th december was choosen because it corresponds with the official birthday of the late H.M. KING BHUMIBOL ADULYADUJ king of thailand who was one of the main proponents of this initiative.

SOIL – AN INDISPENSIBLY ENTITY

Mr.L.SRIRAM, III B.Sc, (Hons>) Agriculture, Palar Agrricultural College

SOIL-AN INDISPENSABLY ENTITY

WHAT IF I SAY THE ECONOMY OF THE NATION DEPENDS ON THE SOIL? SOUNDS DIFFERENT? MAYBE, BUT IT'S A FACT TO BE ACCEPTABLE! IN RURAL AREAS, THIS ORDINARILY INDICATES THE PLANT'S GROWTH, PRINCIPALLY AS CROPS AND RANGELAND, BUT ALSO AS RECREATION ZONES. YES AGRICULTURE IS THE BACKBONE OF INDIA'S ECONOMY, RIGHT? IN URBAN OR SUBURBAN AREAS, THE MOST LINEAR COMMERCIAL ADVANTAGES OF SOIL CORRELATE TO ARCHITECTURAL MAINTENANCE FOR BUILDINGS, ROADS, AND PARKING. LANDSCAPING, GARDENING, AND PARKLANDS MAY ALSO GET ASSESSED ECONOMICALLY BY ELEVATING TOURISM. THE ASSOCIATION LINKING LIFE BORN IN THE SOIL AND THE WELLBEING OF THE PLANTS THAT FLOURISH WITHIN IT IS INTEGRAL. SOIL RENDERS ECOSYSTEM ASSISTANCE, WHICH IS DECISIVE FOR LIFE. WELL, IT ALSO ACTS AS A WATER FILTER AND A GROWING MEDIUM. SOIL FURNISHES HABITAT FOR BILLIONS OF ORGANISMS, CONTRIBUTING TO BIODIVERSITY. SOMETHING THAT YOU NECESSITATE TO APPREHEND. THE SOIL IS THE CORNERSTONE OF OUR NATION'S AGROECOSYSTEMS. SOIL IS THE FORTITUDE OF OUR FOOD ASSURANCE. WITHOUT SALUTARY SOILS, FARMERS WOULDN'T BE ABLE TO PRODUCE WITH FORAGE, FIBER, FOOD, AND FUEL.

NOW, TRY TO ANALYZE THE FACTS. SOIL IS OUR LIFETIME MAINTENANCE SYSTEM. IT'S RESIDENCE TO INNUMERABLE MICRO-ORGANISMS THAT IMPLANT NITROGEN AND DECAY ORGANIC MATTER. IT IS ALSO HOME TO TROOPS OF MICROSCOPIC CREATURES AS WELL AS EARTHWORMS AND TERMITES. SOIL ENDURES THE KEY TO EARTH'S ANTIQUITY, HOLDING AND PROCESSING ARTIFACTS OF THE PLANET'S HISTORY, BOTH ITS NATURAL AND CULTURAL FORERUNNERS. YOU CAN PRAISE SOIL FOR THOSE DINOSAUR SPECIMENS EVERY KID ADMIRES TO SEE AT A TYPICAL CHRONICLE MUSEUM AS WELL AS THE MONUMENTS THAT TELL US HOW OUR HUMANKIND EMERGED. AND CRUCIAL TO EARTH'S EVENTUALITY, SOILS, AND HOW WE USE THEM TO IMPERSONATE AN IMPORTANT ROLE IN ENCOURAGING US TO LABEL CLIMATE CHANGE. SOIL ORGANIC MATTER IS ONE OF OUR MAJOR POOLS OF CARBON, PROFICIENT IN PORTRAYING IT AS EITHER A SOURCE OR SINK. SOIL COMPRISES THE FOSSIL FUELS THAT MANAGE CLIMATE CHANGE WHEN EVOKED BUT WHEN LEFT UNDERGROUND PROFFERS US THE PROBABILITY TO CONQUER THE GREENHOUSE GAS EMISSIONS THAT DRIVE CLIMATE CHANGE AND STRETCH OUR EVENTUAL GOAL OF A ZERO-EMISSIONS WORLD.

I HOPE YOU ARE WONDERING ABOUT THE WONDERS OF THE SOIL. THERE ARE MILLIONS OF MYSTERIES STILL HIDDEN OVER THERE. LET'S TAKE A MOMENT TO PLEDGE NOT TO WASTE SOIL, AT ANY COST.

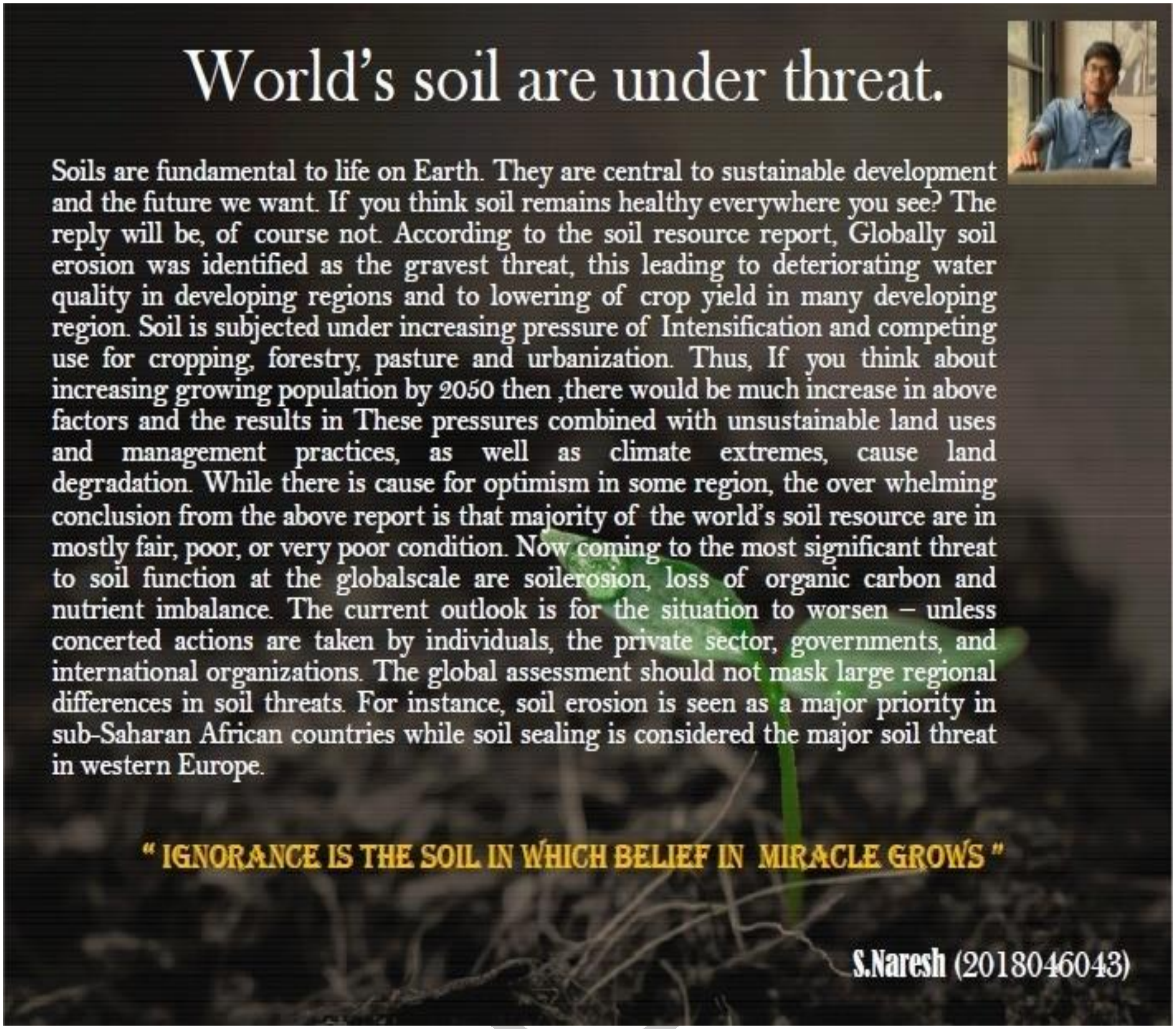
BY:

L.SRIRAM 2018046072

"To forget how to dig the earth and to tend the soil is to forget ourselves."

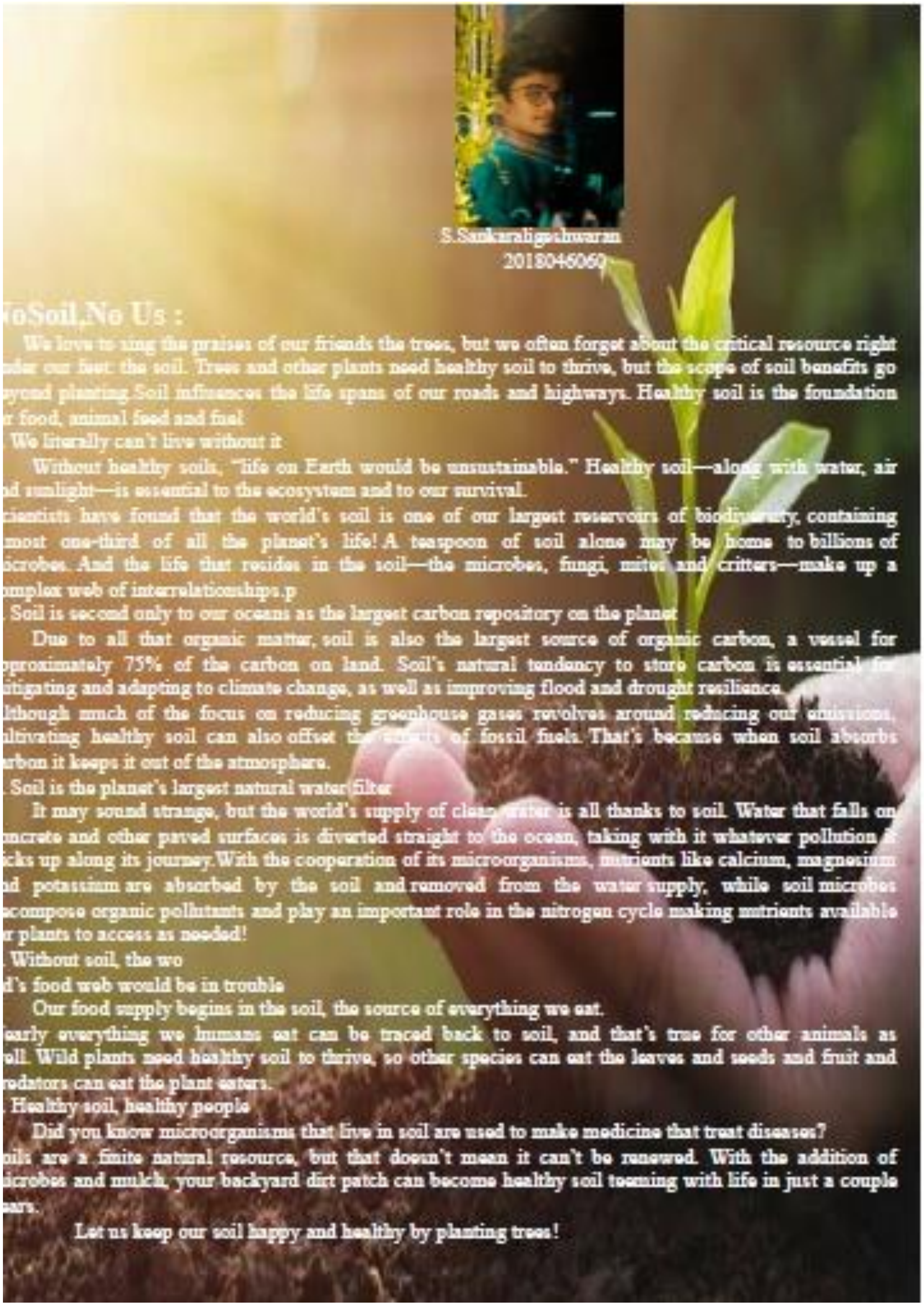
WORLDS SOIL ARE UNDER THREAT

Mr.S.NAresh, III, B.Sc, (Hons/.) Agriculture, Palar Agricultural College



NO SOIL NO US

Mr.S.SANKARALINGESHWARAN, III B.Sc,(Hons.) Agriculture, Palar Agricultural College



S.Sankaraligeshwaran
2018046060

oSoil,No Us :

We love to sing the praises of our friends the trees, but we often forget about the critical resource right nder our feet: the soil. Trees and other plants need healthy soil to thrive, but the scope of soil benefits go eyond planting.Soil influences the life spans of our roads and highways. Healthy soil is the foundation r food, animal feed and fuel

. We literally can't live without it

Without healthy soils, "life on Earth would be unsustainable." Healthy soil—along with water, air nd sunlight—is essential to the ecosystem and to our survival.

cientists have found that the world's soil is one of our largest reservoirs of biodiversity, containing most one-third of all the planet's life! A teaspoon of soil alone may be home to billions of icrobes. And the life that resides in the soil—the microbes, fungi, mites and critters—make up a omplex web of interrelationships.p

. Soil is second only to our oceans as the largest carbon repository on the planet

Due to all that organic matter, soil is also the largest source of organic carbon, a vessel for pproximately 75% of the carbon on land. Soil's natural tendency to store carbon is essential for itigating and adapting to climate change, as well as improving flood and drought resilience.

lthough much of the focus on reducing greenhouse gases revolves around reducing our emissions, ultivating healthy soil can also offset the effects of fossil fuels. That's because when soil absorbs rbon it keeps it out of the atmosphere.

. Soil is the planet's largest natural water filter

It may sound strange, but the world's supply of clean water is all thanks to soil. Water that falls on oncrete and other paved surfaces is diverted straight to the ocean, taking with it whatever pollution it icks up along its journey.With the cooperation of its microorganisms, nutrients like calcium, magnesium nd potassium are absorbed by the soil and removed from the water supply, while soil microbes ecompose organic pollutants and play an important role in the nitrogen cycle making nutrients available r plants to access as needed!

. Without soil, the wo

d's food web would be in trouble

Our food supply begins in the soil, the source of everything we eat.

early everything we humans eat can be traced back to soil, and that's true for other animals as ell. Wild plants need healthy soil to thrive, so other species can eat the leaves and seeds and fruit and redators can eat the plant eaters.

. Healthy soil, healthy people

Did you know microorganisms that live in soil are used to make medicine that treat diseases?

oils are a finite natural resource, but that doesn't mean it can't be renewed. With the addition of icrobes and mulch, your backyard dirt patch can become healthy soil teeming with life in just a couple ears.

Let us keep our soil happy and healthy by planting trees!

SOIL DIRTS

Ms.G.Gowthami, III B.Sc,(Hons.) Agriculture, Palar Agricultural College

G.GOWTHAMI

SOIL DIRTS

" The ground beneath our feet plays a role in everything from food to flood "

Most of what we see are mineral particles that we recognise as sand,slit or clay.there's also plenty of water and air.but soil is alive.it contain countless fungi and microbes. they help recycle the dead by breaking down the remains of plants,animals and otherorganisms.

More than dirt

if you wereto divide the soilsample into 20 parts,9parts would be made of stuff we think of as dirt:clay,slit and sand. these are inoragnic particles,which means they come from non-living sources.a full half,or 10 parts would be equallu divided between air and water.the last part would be organic ,made from dead and decayed organisms.the soil also would contain coundless numbers of minuscule microbes,mostly fungi and bacteria.

Feeding the crop that feed us

we know plants provide us food,but plants are feeded by some microbes.they help in plant growth by providing them essential nutrients.such as nitrogen and phosphorus.some plants are particularly depend on those microbes.like legumes.

" LAND IS NOT MERELY SOIL,IT IS A FOUNTAIN OF ENERGY FLOWING THROUGH A CIRCUIT OF SOILS,PLANTS AND ANIMALS

THEME OF WORLD SOIL DAY 2020

Mr.G.Muthukumar,, III B.Sc,(Hons.) Agriculture, Palar Agricultural College

SINCERE THANKS TO
OUR BELOVED
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GENERAL MANAGER – Mr. S. SRINIVASAN
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