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Research Paper

The Impact of Organic Manure in Greenhouse Cultivation of Tomato: A Review

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ABSTRACT
Farming under greenhouses provides a controlled setting for agricultural crops, resulting in consistent production regardless of external conditions. This review discusses the impact of organic manure on tomato cultivation in greenhouses, with an emphasis on soil health, crop productivity, and environmental sustainability. With limited technical knowledge available for greenhouse vegetable production, particularly inorganic systems, this study aims to improve understanding of nutrient management strategies and encourage sustainable agriculture practices. Sustainable agriculture, guided by concerns about ecological balance and long-term viability, emphasizes the need to abandon traditional chemical-based farming practices. Organic nitrogen, an essential component of sustainable farming, has not been explored as compared to inorganic species due to sampling and measurement problems. The use of protected cultivation techniques, particularly in Sub-Saharan Africa (particularly Nigeria) and Asia, provides prospects to improve food security and economic development. In the wider context of tomato agriculture, choosing proper varieties, soil management, irrigation techniques, disease management, and the use of compost and cover crops are all essential to optimizing yield and sustainability. This review sheds light on the possible use of organic manure to improve tomato production in greenhouse environments by thoroughly reviewing the available literature.

KEY WORDS: *Greenhouse, protected Cultivation, Organic manure, Soil health Environmental sustainability, Organic farming, Organic waste Sustainable*

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I. INTRODUCTION

Greenhouse technologies make it possible to grow agricultural crops in a controlled atmosphere, regardless of environmental variables. Greenhouses are used for the commercial cultivation of vegetables such as tomatoes, cucumbers, bell peppers, melons, and other crops.[1] Greenhouse farmers who grow vegetables require additional study on organic production due to limited technical information accessible.[2]

Generally, a green house may be defined as a frame or inflated structure covered with transparent or translucent material in which such crops are grown under at least partially controlled climatic conditions so that persons or animals may enter and work on it.

Protected cultivation has been defined as a kind of technique for cropping, in which, during its growing period partially or totally, the microclimate around the plant body is designed with regard to the need of each plant species under cultivation at that point.

In India, the area under protected agriculture has increased in recent years from 500 hectares to over 5000 ha. Roses, gerberas, carnations, and other flowers are commonly grown in poly houses in Maharashtra, Karnataka, Uttrakhand, and Gujarat. Orchids and Anthurium are grown in net houses or polyhouses in Sikkim, Arunachal Pradesh, Goa, and Kerala.[3]As stated by Ekelund and Tjärnemo (2004), organic food is regarded as healthier and more pleasant than conventional stuffs. Farmers may experience decreased yields with organic crop cultivation compared to conventional methods. Providing adequate and balanced nutrients from organic fertilisers at the appropriate time is an important task.[4]

Organic agriculture methods promote the use of organic waste as a substitute for chemical fertilisers. Using urban yard waste and waste organic materials from dairy, poultry, swine, or greenhouse operations could have significant environmental benefits. The nursery industry has developed recommendations for using waste and compost products, which could be applied to organic production conditions. Adding organic waste to soil or potting media can improve porosity, waterholding capacity, and biological qualities.[5] Cherry tomatoes are an indicating addition to the soaring micro vegetable industry. Filgueira (2000) describes these fruits as having small in stature (15-25 g), a bright red colour similar to cherries, with a good flavour. Vegetables are an important part of a healthy diet due to their diverse colours, flavours, vitamins, and minerals.Tomato cultivars are now able to be grown year-round in greenhouses with soil or hydroponics. This crop's ideal nutritional content and widespread use make it a primary source of vitamins and minerals in many nation.

The cherry tomato is an exotic produce that adds a unique flavour and appearance to recipes and appetisers. Its small size minimises waste. According to Filgueira (2000).[6]

The objective of this research is explore the influence of organic manure in the production of tomato crop under greenhouse technology, focusing on soil health, crop yield, and environmental sustainability, with a view of improving knowledge regarding nutrient management techniques in organic farming practices as well as encouraging sustainable agricultural practices in greenhouse cultivation of vegetables.

I.1 SUSTAINABLE AGRICULTURE

Sustainable agriculture is farming in sustainable ways meeting society's present food and textile needs, without compromising the ability for current or future generations to meet their needs. It can be based on an understanding of ecosystem services.

I.2 WHY WE ARE ADOPTING SUSTAINABLE AGRICULTURE

Traditional agriculture has been historically oriented, with two interrelated objectives of maximization of production and profit, which have not been designed with the unseen, long-term side effects on the ecological equilibrium of agro-ecosystem and the diversity of habitat. Overuse of chemical fertilizers, such as urea, ammonium sulphate, DAP, TSP, and MOP, among others, pesticides in cotton, paddy, and sugarcane, herbicides, and insecticides, increases the input cost and lowers the profit margin for farmers. This not only erodes the humus of the soil but also severely decreases the red worms. Equally, wrong ways of utilizing ground natural resources in the pursuit of the race against time to meet organizational objectives or profitability. Dangerous chemical residues on food-stuff are dangerous to human life. The most hazardous consequence of over ever-use is the appearance of new, violent insect populations more potent than the chemical pesticides to which they build up resistance. Sustainable agriculture is a well-known and an utmost important concept that acts as a guideline to the farmers to train on varied types of alternate farming systems and methods. According to Prasad and Power (1997), sustainable agricultural practices are now part of the agenda in governments with respect to agricultural institutions all over the world and may be one answer to harmful farming concerns that can allow profitability of food quality and safety. Studies show that farmers are very open in shifting to sustainable agriculture and that it will have to be guaranteed that sustainable agriculture is definitely in place through the harmonization of the efforts of its stakeholders. He further found the link of the dimension of the quality of life of farmers with the attitude that they hold towards sustainable agriculture. Further research comes up to classify the intention of farmers to pursue sustainable agriculture as an effective indication of adopting sustainable agriculture.[7]

1.3 ORGANIC NITROGEN

Atmospheric organic nitrogen exists in gaseous, particulate and aqueous phases and has scientific recognition as its quantitative data contributions to total airborne nitrogen can be identified. The reason as to why tardiness in addressing organic N as compared to inorganic species can be linked to lack of accuracy in sampling and measurement techniques as well as the high number of distinct molecules that contribute to the total organic N. This, of course, has predisposed it to caution and an understandable tentativeness in relating to material deposited from the atmosphere rather than produced in it—the collection of rain through the biological transformation of inorganic N, or some other artifact of the sample.

However, detailed studies of sampling protocols, state storage conditions, and the means of chemical analysis have shown that water-soluble organic N (WSON), which usually comprises a large part of the total water-soluble N (about 30%), can be precipitated in a relevant coagulant dose.[8]

Nitrogen is usually the toughest item to be balanced in terms of naturally growing crops. Composts and covers crops may present useful nitrogen to the crops but controlling their release to the demand of the plant may be quite difficult. Commercial organic nitrogen nutrients are possible and can be purchased but their prices might be quite high depending on the conditions. Proper management of these organic sources of nitrogen is therefore of paramount importance in matching crop demand with minimum impacts on environmental quality. Nitrogen often becomes the most limiting factor in growing surface crops effectively and economically. Inadequacy of nitrogen supply inhibits growth, cuts the protein content of the produce, the yield potential as well as the water-use efficiency of the plant. Plants under nitrogen stress are more prone to diseases than those that are healthy. Excessive nitrogen contributes to poor growth of crops and poor quality of crops aside from increasing the environmental damage. Leads among the most researched plant nutrients compared to the rest. [9]

Dairy waste is a valuable basic material for composting. usually manure is separated using a rotating drum, with the liquid phase recycled in oxygenation tarns and the solid phase brokendown. Co-composting with agricultural by-products, like dairy waste, can reduce nitrogen loss and enhance plant quality.[10]

1.4 RETURNING TO SUSTAINABLE FARMING TECHNIQUES

Agriculture does not just mean producing food but contributes to a vital part of the human culture. The developments in agriculture have substantially transformed the natural environment, local societies, economies, and cultures throughout the millennia.

Directly pointed out by the UN, it can be said that sustainability in agriculture and food systems should be robust and guaranteed to make it sure that healthy food will be enough for everybody without more pain to the ecosystem the farmers inhabit. For Eyhorn and others, it will dawn that the post-2015 2030 Sustainable Development Goals espoused by the United Nations can only be met if agriculture and food systems are urgently transformed. This, in turn, furthers the sustainable agenda in agriculture, including agroecology, conservation agriculture, forestry practices, crop and forest species diversity, appropriate crop and forest rotation, integrated pest management, pollinator conservation, rainwater harvesting, and range and pasture management, and precision agricultural systems. Some of these include the organic food, which has proved to be among the most appreciable sustainability option by people from all corners of the world.

Organic agriculture leads to relatively tight energy and short supply chains; from an ecological viewpoint, this expansion of organic agriculture will not only evolve into an integration of a complete agriculture ecosystem, but it also leads to unique Refinement.[11]

Some of such factors to influence that include; the size and characteristic of the farm, membership to the agricultural associations, the chance of obtaining the technical and economic support among others. For example, some of these studies show that a large farm is possible to be handled in a rather difficult way compared to small farms; these thus suggest that most of the farmers have got little motivation to start with their conversion. Therefore, Organic farming is more likely to be adopted by many of the small family farms. [12] The dependability of the organic farming will to a large extent depend on insights the policy makers will get in relation to the motivation of the conventional farmers in conversion to organic farming. Organic farming has attributes common to other agricultural technologies in relation to adoption and diffusion process. Hence it has attracted an overabundance of literature in the adoption and diffusion of technology in agriculture.

On the other hand, most general studies in this realm are associated with classic contrasts between adopters and non-adopters of a technology, and very rarely have there been empirical studies that have analyzed differences between early and late adoption of new technologies. technologies in general and organic farming in particular.[13]

II. BENEFITS OF SELECTING TOMATO UNDER PROTECTED CULTIVATION

Tomatoes are native to Mexico and Peru. This herbaceous plant reaches a height of 1-3 meters and has a weak woody stem. It is widely recognized as 'Protected Food'. It contains 31 milligrams of vitamin C per 100 grams. The blossoms are yellow, and the cultivated variety ranges in size from cherry tomatoes (1-2 cm) to beefsteak tomatoes (10 cm+). Tomatoes are grown in 700 different types globally. This vegetable crop is important for both commercial and culinary purposes because of its short duration and high production. It is also economically significant, leading to an increase in growing areas.

Progressive farmers are currently using commercial protected cultivation for high-value crops and flowers. Here are some reasons why shielded tomato cultivation is preferred.

- Improved produce quality.
- Increased productivity.
- Plant nursery rearing and hardening.
- Improved insect and disease control with less insecticides.
- Off-season cultivation.
- Resources are used efficiently.[14]

III. CURRENT STATUS OF PROTECTED CULTIVATION IN THE WORLD

According to the most recent data from the Food and Agriculture Organization of the United Nations (FAO), the global area under protected cultivation of horticulture crops is expected tobe approximately 623,302 hectares in 2023, with China accounting for the majority (45%).Other prominent producer are Turkey, Spain, Italy, and Japan.

On average, the production of tomatoes in protected cultivation is around 30-40 kg/m2, but the average yield in fields that are open cultivation is around 10-15 kg/m2. The global production of horticulture crops under protected cultivation is expected to be over 150 million tons. Major crops produced under protected cultivation include vegetables (tomatoes, cucumbers, peppers, lettuce, etc.), fruits (strawberries, raspberries, blueberries, etc.), and flowers (roses, gerberas, carnations, etc.). [15]

3.1 STATUS OF PROTECTED CULTIVATION IN AFRICA SUB-SAHARA

The greenhouse technology has not been widely adopted in Sub-Saharan Africa, leading many farmers to miss out on the benefits and practicality of greenhouses. This indicates a widely overlooked possibility to close the knowledge gap. Farmers in the Gusii highlands in Southwest Kenya abandoned greenhouse farming after the first crop cycle, despite initial investment in the technology. The abandonment of greenhouses is becoming a growing tendency. In Nigeria, a survey was done to identify the obstacles that prompted greenhouse abandonment in several sections of the country.

In Nigeria, many greenhouses were used just for research purposes, and efforts to encourage locals to use greenhouses to supplement their income were unsuccessful. Just providing previously inaccessible technology to farmers is insufficient to ensure proper understanding and application.

Many farmers in Nigeria and Kenya were unable to shift to greenhouse farming due to a lack of initial effort to understand both existing techniques and their needs. Greenhouses are sometimes prohibitively expensive and unfamiliar to the local society as a whole.

To overcome abandonment, the strategy of knowledge transfer should be designed towards the farmer and farming practices, instead of just the technology itself. In reality, the additional knowledge and skills that greenhouses require in the agricultural process may act as an opportunity for an effective way to meet local needs.[16]

3.2 STATUS OF PROTECTED CULTIVATION IN ASIA

Asia had an extensive heritage of protected cultivation of horticultural crops, which adapted from their pristine forms by covering fruits and vegetables in the winter with hay straw blankets or other materials that were readily accessible. Today, there are many forms of protected cultivation in Asia that offer an improved method than the open field for boosting the variety, quality, and off-season output of vegetables, fruits, and ornamental objects. In addition to greenhouses.

Protected cultivation methods in Asia are diverse, from broad cultivation facilities in Japan to several-layered (up to eight) lean-to solar greenhouses in China to low-cost row curtains. China, South Korea, Japan, and Taiwan in East Asia likely hold more areas under protected cultivation than the rest of the globe together and they have different kinds of protection that may be applicable in many parts of the world.[17]

3.3 CURRENT STATUS OF PROTECTED CULTIVATION IN INDIA

India is the second-world's leading producer of fruits and vegetables, accounting for 10.49% of global production of fruits and 11.15% of global production of vegetables. Protected cultivation technologies are being implemented in several states, including Chhattisgarh, Odisha, Andhra Pradesh, Gujarat, Madhya Pradesh, and Maharashtra.

Maharashtra happens to be one of the states with a majority of protected agriculture areas. The central and state governments establish a variety of policies and initiatives that promote and advance protected horticulture. The National Horticulture Mission (NHM) is the most prominent plan among farmers. The program offers a 50% subsidy for the establishment of protected cultivation structures and a 50% subsidy for planting materials of flowers and vegetables grown in protected cultivation.

Apart from this, the Maharashtra Industrial Development Corporation (MIDC) has created a floriculture park in Talegaon, Pune. The Indian Council of Agricultural Research (ICAR), which is part of the Ministry of Agriculture and Farmers Welfare, established the ICAR- National Research Centre for Grapes, the Directorate of Onion and Garlic Research, the ICAR-Directorate of Floricultural Research, and the ICAR-NationalResearch Centre for Pomegranate.

In addition, extension services were established to assist stakeholders and conduct research on the many crops farmed in the region. Pune district has been designated as an Agri Export Zone (AEZ) for floriculture, and the state agricultural marketing board has opened the Horticulture Training Centre in Talegaon Dabhade, Farmers are trained at this center in green/poly house management, with the emphasis on floriculture.

Furthermore, multiple governmental and commercial nurseries were constructed to supply the planting material requirements for both protected and open field environments. All of these efforts were aimed at increasing the profitability of protected cultivation technology, and thereby farmers' income. [18]

3.4 CROP STATUS UNDER PROTECTED CULTIVATION

VEGETABLES SEEDS PRODUCTION

3.5 TOMATOES (LYCOPERSICON ESCULENTUM)

Solanaceous crops such as tomatoes, brinjal, and capsicum were responsible nearly 60% of protected Cultivation area. Tomatoes are the most researched crop in the Solanaceae family. Tomatoes (Lycopersicon esculentum) are the world's most widely produced vegetable crop by land. They are primarily grown in greenhouses during the winter and spring. To ensure optimal vegetative and reproductive development, tomatoes require a high water potential. The total water need of the tomato crop is projected to be 65.12 L plant-1(257.4 mm) for the Sahdenet house, followed by 56.6 L plant-1(226.6 mm) for the polyhouse and 56.3 L plant-1(225.1 mm) for the Shadow Hall.

Capsicums (Capsicum annum L.) are a major crop in many parts of the world due to their economic significance and positioned as the second most produced crop globally. The recommended temperature range for capsicum growth is 20 to 25 degrees Celsius. Temperature fluctuations between 15°C and 32°C usually cause development to stop and yield decrease. The seasonal water requirement of a Capsicum crop grown under PCS is projected to be 56.92 L plant-1 (252.9 mm) for shade net, followed by 49.20 L plant-1 (218.7 mm) for poly house and49.11 L plant-1 (218.28 mm) for shadow hall. Compared to other structures, the open field condition predicted a greater water need of 76.45 Lplant-1 (339.76 mm).

3.6 CUCUMBER (CUCUMIS SATIVUS L.)

Cucumber (Cucumis sativus L.) belongs to the warm-season crop that grows best at temperatures that vary from 18°C to 24°C. This vegetable crop is subtropical and grows successfully in greenhouses with high light, humidity, soil moisture, temperature, and fertilizer levels. Cucumber has a considerably lower yield than other crops since the crop area is much smaller, at 0.13 m2 per plant. Chilling injury in cucumbers is a physiological problem that happens when sensitive plants are exposed to cold temperatures below 12°C. Heating injury causes slowed growth, decreased photosynthetic capability, necrosis and discoloration, irregular maturation, and increased disease susceptibility.[19]

3.7 BRINJAL

Brinjal may now be grown under protected conditions for the reason of the development of parthenocarpic hybrids.

3.8 CORIANDER

Isaac S.R. (2015) discovered that coriander develops and grows effectively in naturally ventilated polyhouses, resulting in increased biomass production.

3.9 CAPSICUM

Capsicum is the most commonly grown vegetable in greenhouses and provides better returns.[20]

IV. BENEFITS OF PROTECTED VEGETABLE CULTIVATION

1.Protective structures help high-value crops from harsh weather conditions, pests, and disease states.
2.It enables the development of high-quality, healthy vegetable seedlings for transplantation in open fields, boosting early crop, strong, and resistant crop stands.
3.It enables vertical growing of vegetables utilizing technologies such as hydroponics, aero- ponics, and the utilization of vertical beds for production.
4.It offers vegetable growing in regions where it would be impossible in open circumstances, such as high altitude deserts.
5.It is possible to produce fruits and vegetables off-season in order to get more for your money on investment.
6.Vegetables can be cultivated throughout the year, in any season. Conditions that are unfavorable for vegetable cultivation can be overcome using various shielded production systems.
7.It is suitable to have multiple crops on the same piece of land.
8.Disease-free seed production of valuable vegetables becomes easier with protected construction.

4.1 THE CONSTRAINTS OF PROTECTED CULTIVATION

1.Manual or hand pollination in cross-pollinated vegetables such as cucurbits, or the generation of parthenogenesis hybrids/varieties.
2.A lack of adequate tools and machinery.
3.The greenhouse's cooling and heating system requires an uninterrupted and regular power supply, which is not easily accessible in practically every section of the country.
4.At first view, the structure's cost appears prohibitively expensive. Farmers who can afford to take no risks do not adopt it.
5.Lack of support from planners and scientists leads to limited availability of suitable varieties/hybrids and production packages for protected production systems. Additionally, protected structures are not scientifically developed, limiting their potential.[21]

V. AGRICULTURALPRACTICES UNDER PROTECTED CULTIVATION

5.1 SELECTION PROCESS OF SPECIES AND HYBRIDS FOR PROTECTED CULTIVATION.

The selection of varieties and genotypes for protected cultivation is an important aspect that may significantly influence the final outcome and financial return of the production process (La Malfa and Leonardi, 2001). Good agricultural practices in greenhouse culture include selecting genotypes that are most suitable to a certain agricultural context, even though the process is complex with a broad spectrum of options to think about.

5.2 FARMERS CAN CHOOSE FROM TWO BASIC OPTIONS.

1.Select a species with great economic potential and establish the most proper protection, growth systems, and technologies.
2.Pick a crop that is fit for the farm's current buildings and take advantage of them.

5.3 SELECTION OF THE CROPS

In moderate winter climates, cool greenhouses and protected cultivations target producing vegetables from the Solanaceae (tomato, pepper, eggplant) and Cucurbitaceae (melon, summer squash, watermelon, cucumber) categories. These crops, which cover over 80% of protected areas in most Mediterranean countries, grow in cold temperatures greenhouse conditions and correspond with local market needs.
When selecting crops, it is essential to think about market and economic conditions, crop characteristics, compatibility with microclimates, soil characteristics, and soil-borne diseases.

1.Market demands
2.Economic and social surroundings
3.Location from markets.
4.Plant dimensions
5.Crop requirements
6.Manpower requirements
7.Weather conditions 8.Features of Protection Means
9.Ability of active climate control.
10.Soil properties and soil-borne illnesses.

5.4 SELECTION OF CULTIVARS

Selecting an ideal cultivar is important for greenhouse production cultivar, selection has significance for each crop and specific produce type. Cultivars with different fruit qualities are unsuitable for greenhouse production due to challenging market and production constraints. Protected cultivating cultivars have higher output potential due to reduced environmental constraints compared to open-field vegetable production.
Cultivar-specific requirements may vary based on the level of technology utilized in protected agriculture, such as cultivars designed for long-cycle crops.[22]

5.5 MANAGEMENT THE CONDITION OF THE SOIL IN ORGANIC GREENHOUSES

Soil health refers to the soil's ability to function as a biological system within ecosystem and the use of land boundaries. A healthy soil can be identified by complex food webs with great microbial and faunal variety, a scarcity of easily decomposable carbon sources, limited nutrient losses, adaptive capacity and resistance, and pest and disease suppression.

In phytopathological view , soil infestation by pathogens from external sources is a biotic disorder, and soil suppressiveness is a resilience mechanism to reduce disease outbreaks. Soil suppressiveness refers to the soil's ability to maintain low disease prevalence or severity in the presence of a pathogen and an ideal environment. Soil suppression can occur naturally, as in Fusarium-suppressive soils, or through agricultural techniques like composting or solarization. In many circumstances, soil suppressiveness is linked to microbial biomass, activity, and diversity. For example, Fusarium oxysporum f. sp. lini suppresses flax wilt in organic greenhouse soil. Therefore, any behavior that negatively impacts these variables will also lower suppressiveness.[23]

5.6 SOIL PREPARATION

When cultivating soil, keep in mind that plants require well-aired soil for effective drainage. Water retention should be prevented at all costs. Plants develop in a rooting environment made up of one-third soil, one-third air, and one-third water. The expert grower should have had minimal trouble preparing the soil.[24]

5.7 WATER AND NUTRIENT MANAGEMENT

Water quality is essential for greenhouse horticulture growth. Knowledge of available water quality helps for the planning of water treatments, avoiding production restrictions caused by poor plant development, discoloration, clogged watering pipes, and other undesirable consequences. Under commercial conditions, irrigation water comes from a variety of sources, and hence its fundamental quality alters. Although there is no standard analysis type for every situation, analytical testing should be undertaken on a frequent basis to avoid losses caused by variations in water composition.

In addition, daily pH and EC testing of the water circulating in the greenhouse is recommended in order to intervene quickly in the event of unexpected changes in the salts dissolved in the irrigation water. When the quality elements for allowing plant cultivation are established, sustainable irrigation management techniques must be addressed in order to protect water sources, increase production, and reduce costs. High water use efficiency in greenhouse production is possible with proper planting methods and environmental conditions. Micro- irrigation is the most efficient irrigation technology, as it supplies water to the root zone at low pressures (<2 bars) on a frequent basis. Micro-irrigation is operated through a network of valves, pipes, tubes, and emitters, and great care should be taken to avoid clogging of the nozzles (e.g., by inserting a filter upstream in the distribution line or cleaning the system with chlorine, nitric, or phosphoric acid).

While planning irrigation for soilless culture, several factors must be considered; in this situation, self-sufficiently regulated irrigation systems are necessary. These can be managed by using inexpensive and dependable instruments, such as weighing gutters or tray systems, for the precise calculation of ETc. Likewise, daily management of the EC and pH of drainage water, as well as monthly monitoring of the same variables in the substrate, are recommended, particularly when using low-quality irrigation water. Finally, for hydroponic production, a scheduling coefficient of no more than 1.5 (Irrigation/ETc) should be used, resulting in a 33% drain fraction.[25]

5.8 IRRIGATION TECHNIQUES FOR PROTECTED CULTIVATION

It is extremely hard to fully profit from protected cultivation without microirrigation and fertigation. Protected agriculture must have an efficient irrigation system, ideally microirrigation, in addition to a fertigation system. Growing plants in a greenhouse requires an irrigation system. Plants require water for growth and develop and because a greenhouse does not allow natural rainfall, artificial irrigation becomes necessary. There are many different irrigation methods, each with has its own set of advantages and disadvantages. Choosing the optimumrrigation method is mostly determined by the size of the protected structure and the plants that grow inside. A combination of methods is often used to achieve the best irrigation results.

5.9.1 OVERHEAD SPRINKLER IRRIGATION SYSTEMS.

Overhead sprinklers frequently offer two options. The first option is rotary sprinkler heads, which have a spinning nozzle that sprays water over plants. The second alternative, stationary sprinkler heads, direct a quick flow of water at a plate. The collision prevents the steady stream of water, transforming it into a continual spray that irrigates plants. Overhead sprinkler systems are the most frequent alternative in nurseries; however, they are inefficient. They require high- pressure pumps, which waste a lot of electricity. Overhead sprinklers also take advantage of approximately 80% of the water emitted. Plants with large or broad leaves in greenhouses promote water waste by redirecting water away from plant containers rather than into the soil. Some gardeners compensate for water loss by creating slanted plant beds that direct water into ponds where it can accumulate and be recycled back into the nursery; however, this may also recycle bacteria, sodium, fertilizer, or diseases.

5.9.2 MICRO-IRRIGATION SYSTEMS

Microirrigation devices work very effectively; they can work even on very low pressure, and sometimes can be very efficient. The emitters could be choked by the soil and algae and by chemical fertilizer, for which there are several types of filters. In the nurseries, three systems are used. The first system is the capillary mat system; the second is microirrigation, in which water uses tubes to apply to a mat. Here, the mat becomes filled with water so that if the containers are placed at the top of the mat, the root systems of the plants absorb water. Capillary mat irrigation uses 60% less water than the standard overhead sprinkler but can accumulate salt in the soil for a period of time.The other type of supplemental microirrigation system happens to be the microsprayer, microsprinkler, or spray stake system. Microsprayers, in use with some of the most ideal nursery irrigation technology, work particularly where a hose coming in from the water goes directly into the ground. Though this design cuts down on water loss of the plant's leaves, it also brings water to a plant's root system directly on contact. They are more expensive when used in the irrigation of small plants but work very well in larger plants where there is a lot of foliage and thus heavier canopies. The spaghetti tube system is the third type of the micro irrigation system. This nursery irrigation technology uses thinnest tubes which transport water up to the plant container. A small weight on one end of the tube holds it down. The capillary forces move water in between the pores. Gardeners tend to do better productivity using uniform and good quality soil. The gardeners using the spaghetti tube method should ensure the soil remains wet always, dry soil leads to water distribution shortage.

5.9.3 DRIP IRRIGATION SYSTEM.

The common efficiency of this method can be equal to 90% - drip irrigation can be substantially the most effective way of watering. In other kinds of irrigation, for example, in the case of ground surface irrigation, runoff and possibilities of losses for evaporation are much fewer. One of the drip irrigation systems' essential features is that it presupposes the presence of tubes run beside the plants needed to be irrigated. These tubes contain emitters, or devices that let water out into the ground. Slowly, as it drips from the tubes, water is supplied to the root zone. This kind of irrigation reduces the leaf, fruit, and stem interacting with water to reduce the infection of the plant. It inhibits growth of weeds because it dries the space between the plants. Racing irrigation by use of this method can either be automatic or manually controlled. The dripping is a secure way of watering greenhouses and tunnels because it maintains low humidity levels. This way, water is directed exactly where it is needed, be it to an individual dripper perfect for container-grown plants or into a pipe for beds; the ideal system in this case would be through a pipe into the beds, A pipe being a good system for raised beds.

VI. TOMATO CULTIVATION IN PROTECTED ENVIRONMENT

6.1 CHOOSE A VARIETY.

◆ Generally, indeterminate growth habits are not suitable in greenhouses. Do not use the cultivars developed for the field production in the greenhouse. The seeds are cheap, and they are not well adapted into low light and disease pressure in greenhouses.

◆ Pant Polyhouse tomato-2 and Pant polyhouse hybrid tomato-1 are some of the cultivar types from Pantnagar that it has developed for growing in a greenhouse. Some of the indeterminate cultivar types from commercial companies include Himsona, Badshah, and Vaishali.

6.2 WHAT AND HOW MANY CROPS SHOULD BE RAISED EACH YEAR?

6.2.1 LONG-SEASON CROP

seeds were placed in germination trays in late September.

◆ Producing one crop per year allows for continuous tomato harvesting from December to the end of June.

◆ The expected lower rainfall and low humidity in January and February will lead to lower average plant production. The lower average plant production was realized when compared to the fall and spring crop combined yield. Long season crops are also more prone to diseases and pest problems compared to the short one season ones. Pest management is also difficult and relatively expensive for the matured crops compared to the young ones.

6.2.2 FUELING GREENHOUSE TOMATO PLANTS.

◆ Tomatoes need at least 15 necessary nutrients for optimal development and production.

◆ Higher amounts of potassium, nitrogen, phosphorus, calcium, magnesium, and sulfur are required.

◆ Boron, iron, manganese, copper, zinc, and molybdenum are minor elements essential in lesser quantity.

◆ These parts, where the majority or major part of the tomato plant, are a combination of carbon, hydrogen, and oxygen; they are systems in part from air and water.

◆ Greenhouse-grade fertilizers are frequently chosen over common grades due to their enhanced purity and solubility.

◆ Small growers might buy pre-mixed fertilizers to avoid mistakes while mixing the mix oneself.

6.2.3 FERTILIZER APPLICATION.

Do not feed your greenhouse tomatoes at a high nitrogen rate, since this can cause blossom- end rot. Excess nitrogen might come from increased application rates or irrigating with low nitrogen concentrations, necessitating flushing to remove the excess fertilizer. Ammoniate nitrogen use has been attributed to an increase in blossom-end rot incidence due to probable potassium and calcium shortages. Additionally, fertilizers containing salts such as potassium chloride or sodium nitrate may introduce undesired components, causing stress in tomato plants, especially in hot weather. Using high-electric conductivity (EC) fertilizer solutions might exacerbate water absorption concerns, resulting in increased stress in tomato plants.

6.2.4 SPACING GREENHOUSE TOMATO PLANTS.
A single plant of the tomatoes should occupy at least four square feet inside the greenhouse. To approximate the total number of the tomato plants, take length by the breadth and divide by four. You can plant in a greenhouse. A 30 by 96 feet wide greenhouse can take up to 700 plants.
Accurate spacing is required for even distribution of light.
The rows are best oriented north-south.

6.2.5 SUPPORTING AND TRAINING GREENHOUSE TOMATO PLANTS.
1.Single-stem plants of tomatoes can reach a height of 30 feet and produce up to 4 kilograms of fruit at any time.
2.The powerless stem depends on a robust support system to bear the heavy weight.
3.Stretch an effective wire cable with a diameter of 3/32 inch over each row of tomatoes.
4.plants at a height of 8 feet supported by a sturdy greenhouse frame or metal pillars.

6.2.6 PRUNING GREENHOUSE TOMATO PLANTS.
In tomato plants, the branches or suckers should at least on a weekly base be removed to maintain the single-stemmed plants. The suckers should be removed when they are small (1 inch or less) early in the morning during shiny days. A small wound is left after removing the sucker, which recovers fast, therefore; any risk of fungal invasion is minimized.

6.2.7 DISEASE MANAGEMENT UNDER ORGANIC
Such increase in use has led to the development of such microbial BCAs drastically as an effective solution over synthetic pesticides with high biosafety and least bio-impacts. Solar soil heating, also identified as soil solarization, proved the most important process used as a means to affordably and effectively treat soil-borne diseases in an integrated way in both the field and greenhouse. Customarily, Trichoderma spp. are fast-growing, aggressive biological control agents for plant disease, with different commercial products proving most useful when applied to field- or greenhouse-grown crops. This product has been reported to cure the spectrum of soil-borne diseases caused by various pathogens such as F. oxysporum, Pythium, and Sclerotinia, and also promote plant growth. The mechanisms postulated include Trichoderma helping the crop plant express systemic resistance mechanisms to the susceptibilities to diseases. Compost extracts have therefore gained interest and popularity in the management of diseases in plants with an aim of reducing the usage of the chemical pesticides. The researchers did a great job by using compost for reducing soil-borne diseases in the extracts. Comparisons were made in this study of the effect of thermal soil solarization, that of carbendazim, and that of spent mushroom and Trichoderma harzianum on Fusarium wilt in tomatoes. [27]

VII. FERTILIZATION UNDER ORGANIC CULTIVATION

Author	Compost	Vermicompost	Cover Crop	Remarks
(Clemmensen 2004)	◆ typically have a total nitrogen of between 0.5 to 2.5 ratios. Compost is part of organic wastes from different origins, partly decomposed by aerobic microbes into an exothermal process. Compost from a variety of feedstocks is readily the available natural resources useful in the reduction of environmental impact of waste disposal and recycling of waste in agriculture. ◆ It was further observed that compost might be characterized by physical, chemical, and biological features typical of partially substituted peat in growing medium formulations.	----------------	-----------	These sections provide valuable information on compost's diverse impact in agriculture. It points out compost's dual role as a reneable resource and a solution to waste management issues. These points demonstrate compost's composition,manuf acturing process, and benefits such as nitrogen content and mud substitution, all of which show compost's potential to improve the sustainability of agriculture while reducing

	◆ Compost is a renewable fertilizer. It is derived from diverse feedstock; hence, it offers means that can be used in helping reduce the environmental impacts of disposal and recycling of wastes in the farming industry.			environmental effects.
Pinamonti And Sicher 2001).	◆ Compost is generally a categorization term for many of the substances formed during the process of composting; the end product is usually something not good for growing media since they have to be homogenized. Generally, improving the quality of the raw materials used in composition serves to enhance the performance formulation.	------------	----------	They successfully clarify the diversity of compost ingredients and point out the value of raw material quality for optimal compost performance in agricultural
(Pinamonti et al. 1997;Walker et al. 2006;Roberts et al. 2007;Tittarelli et al. 2009;Ceglie et al. 2015).	◆ However, the usage of compost is limited by uneven properties over time due to changing feedstock sources and inadequate composting process management.The primary business purpose of horticultural nursery activity, however, is to produce universal and healthy seedlings that are not susceptible to the various properties of the growing media utilized. Even so, compost is by far the most extensively studied component of growing media	-------------	----------	Compost's changing qualities due to fluctuating feedstock sources and ineffective composting processes pose a challenge, yet horticultural nurseries prioritize strong, adaptable seedlings, despite its heterogeneity in growing media research.
Domíngue z (2004	---------	◆ Vermicompost is said to be rich in NPK (nitrogen 2-3%, potassium 1.85-2.25%, phosphorus 1.55-2.25%), and describes a stable, finely divided peat-like material with a low C: N ratio, high porosity, useful water-holding capacity that is microbiologically active organic amendments created by the interactions of earthworms and microbes during decomposition of organic materials. The easily absorbable nutrients present in vermicompost can be taken up by plants. Furthermore,vermicomp ost is made under mesophilic conditions in contrast to compost: while the biochemically decomposing matter is present in the microbe, worms are leading regulators of aeration, conditioning, and fragmentation of the substrate, doing so in a manner that penetrates the activity of microbes.	-------------	Vermicompost, a microbial-rich soil amendment produced by earthworms, is high in NPK (nitrogen 2-3%, potassium 1.85–2.25%, and phosphorus 1.55-2.25%). Its low C:N ratio, ideal porosity, and plant-accessible nutrients make it ideal for soil development. Earthworms contribute to the decomposition process, increasing its efficiency.
(Domíngu e z et al., 2010).	-----------------	◆ Earthworms alter the physical and chemical nature of organic matter in such a way to reduce the ratio of C to N so that the	-----------	Further to his argument, he goes ahead to illustrate the characteristics of organic matter within those respective soils and enhances the activity of

		surface area exposed to the microbes for the activity of the microbes takes place even further. This is when worms could be said to act as mechanical blenders.		the microbial population. This, therefore, brings into perspective the inclusion of the earthworm activity in ecological research and approaches to the same.
(Vivas et al., 2009) & (Lazcano et al., 2008),	---------------	◆ Despite some main differences that are due to biological benefits, composting and vermi-composting both are independent biological processes, producing significant differences in bacterial community composition and fungal abundance, although both are prevailing on feedstock organic wastes materials present.	----------	It provided the most important information related to specific biological advantages of composting and vermicomposting procedures. Differences in bacterial community structure and fungal abundance between these procedures justified separation between the distinct effect of these procedures in the transformation of organic waste. This further emphasis on biological differences could increase the knowledge related to the ecological impacts and applicative grade of both compost and vermicompost in a pluralistic eco-system.
(SSSA, 1997)	---------------	----------------	◆ Cover crops are just closely grown crops that serve to conserve and improve soil between times of normal cultivation of crops, or between trees in orchards, and vines in vineyards. They are not produced for selling in the market, but when plowed and integrated to the soils, they can be called green manure crops.	References to a paper by the Soil Science Society of America (SSSA) in 1997 simply bestow the functions and definition of cover crops succinctly within an agricultural system. The authors point out that they contribute to the preservation and enhancement of soils during times of dormancy, in fact, adding to the new idea of the use of cover crops for improved conditions of the soil in a sustainable approach to soil management. The selectivity of this distinction also infers the potential for cover crops and green manure crops as a practical use within agroecosystems.
(Smith et al., 1987), (Meisinger et al., 1991),(Singh et al.2004),(Ranells and Wagger, 1996)	----------------	-----------------	◆ Crops are universally used in the cropping system as a tool for nutrient management. Cover crops may be leguminous—that is, they put nitrogen into the system—or they may be non-leguminous. Legume cover crops supply nitrogen (N) to the next cash crop, and mostly, grasses are used to	Having said that, the authors supported the idea that cover crops added value with respect to nitrogen management in cropping systems and continuously found logical references to the issue. Then, comparison of leguminous with non-leguminous cover crops would firmly underline distinctly the respective functions: legumes supply nitrogen (N), while, among grasses, there is pronounced leaching of NO3 and erosion. The bicultural cover cropping

			decrease leaching and the erosion of NO3. The biological N fixation by the leguminous crops has the potential to diminish the N fertilizer needs of the subsequent crop. It is possible to design a specific legume-grass biculture to impart both benefits simultaneously.	approach supplies a holistic perspective in the quest for extracting the maximum potential from the cover crops approaches.

Figure 1: Fertilization Under Organic Cultivation.

7.1 ADVANTAGE OF APPLYING COMPOST IN GROWING SUBSTRATE

In composting, the source and nature of wastes range from agricultural waste to agro-industrial waste, and from animal manures and slurries. Incidentally, leftover biomasses include sweet corn tassel (Zea mays L.), beached Posidonia residues (Posidonia oceanica L.), spent mushroom compost, switchgrass (Panicum virgatum L.), rice (Oryza sativa L.) hulls, and coconut coir husk (Cocos nucifera L.) extracted.

Other studies observed that compost could also substitute hay in the growing soils. Concurrent examples include municipal solid compost, animal manure compost, green waste compost, and agro-industrial compost. Compost greatly enhances its physical condition—that is, good aeration, light, and friable structure—by improving the chemical status of the growing soils. Compost ensures good availability of macronutrients, micronutrients, and plant growth promoters. On this, this means that the composts can be converted to cultivation media if all these are attained: 50-80 porosity, 25-60 water retention, 0.30-0.75 g/cm3, starting pH 5.5-6.5.

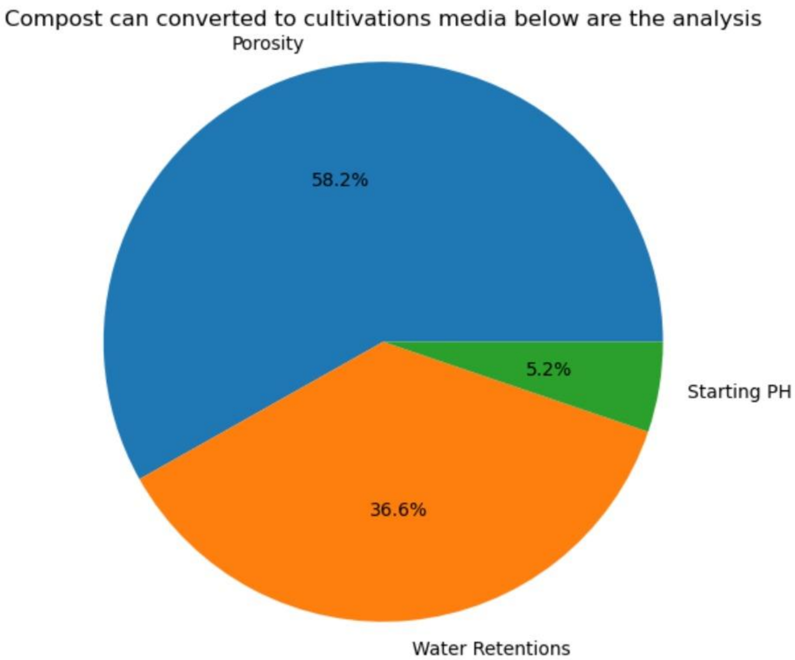

Figure 2:Compost Converted to cultivation Media.

Highly compacted materials reduce the porosity of the propagation medium, although in some cases the former compaction can be ameliorated by mixing either perlite or pumice with the substrate. The major obstacles to the usage of compost in the composition of growing media are high electrical conductivity, somewhat alkaline pH, and low water retention. The soluble salt content of compost varies with both the feedstock used and processing technique. It is believed, according to several studies, that compost with low levels of salt positively facilitates growth better than high-salt- high composts. By the time drainage is complete, the root media should thus be holding enough moisture and the ratio of water to air at an ideal. The growing medium or compost should therefore be safe, low in salinity, low in concentrations of phyto-toxic ions and compounds, and free from plant pathogenic organisms.

Manas et al. (2009) made a review of 19 different papers on the effects of compost addition to growing material on plant nutrition, physical properties, pH and nutrient interactions; effect of growth on pathogenic micro-organisms; stimulation or repression of diseases; and seedling growth.

7.2 BASE DRESSING FERTILIZATION

Animal manures also comprise mature manure, dried blood, hoof and horn, besides dehydrated and pelletized A product comprises animal and/or plant wastes. Besides these, animal manures also lead to products from fish, livestock, food, and other processing industries including fish processing. In particular, nitrogen sufficiency mainly influences the establishment of seedlings in organic systems and this can only be achieved through the use of mineral sources (Nicola and Basoccu, 1994). This process of nitrogen mineralization from solid organic fertilizers can be slow or fast, but it depends mainly on the C/N ratio and temperature.

Badran et al. (2007) estimated the efficacy of fertilizers of rock phosphate and potassium sulfate contained in the compost on the production of organic tomato seedlings. Rock phosphate stimulated composting, which is evidenced by an increase in the decomposition of organic mass, the effect of which then combined with the growth of transplants, while the so-called sulfate effect on the plant was significantly affected. In addition, it will further assist in the ability of phosphorus to become progressively available after adding several diverse microbial agents into the process of composting, e.g. Aspergillus niger, Pantoea agglomerans, Pseudomonas putida. Increased availability of absorbed bacterial in the plant by such bacteria through acidification, or by participating in rhizocyte's acid production—these bacterial increase the intake of phosphorus in plants.

7.3 TOP DRESSING FERTILIZATION METHODS

Popescu et al., (2004) advanced this fact by conducting a study in which media that are used for growing are unable to be successful in organic transplant production without top dressing during plant growth. That in accordance with the previous claim. Yet authors are cautious about the results themselves, admitting that generalization of findings of this work would be difficult, since organic amendments they used varied so much in composition and type, cell size of the trays, and the specific conditions the experiment was conducted under.

The standard fertilizers can be applied for fringes with peat blocks or larger cells that do not have the support of trays in the cooler peripheries. In cases such as high-temperature Mediterranean sites, applying only standard fertilizers can create too much generation of minerals. High-temperature sites such as the Mediterranean which are relied upon by organic farms to supply the needed vegetative cultures apply foliar or root fertilization.

This limits the choices and, in their view, the choice in growth media and methods of fertilization are one of the large problems facing organic seedling production. Foliar application of liquid fertilizers derived from hydrolyzed feather, meat, bone and blood meal for crop fertilization is presented with effective ways of nutrient supplying, and the more detailed one mentioned in herein below. Fertigation is also effective in putting fertilizers on the field as it applies liquid fertilizers directly diluted to the roots. Fertigation increased the uptake of nutrients by the plant and lessens the possible waste of water and nutrients. This indicates that fertigation provides a variety of options since these kinds of systems of fertilization make way for adjustments to suit specific nutritional requirements for various crops on the same substrates and during developmental stages of the same crop in various turns of development. Fertilizers suitable for the use in fertigation must be such that they shall not react with any compounds in irrigation water to generate any insoluble precipitate. A good percentage of the fertilizers are made from dried animal wastes, plant wastes, and by-products from fish, livestock, food, and other processing activities.[28]

7.4 NUTRIENTS IN VERMICOMPOST

Vermicompost is an active, organic soil amendment produced through the decomposition of organic wastes and further processed by passing that mix through the guts of earthworms. The worms' castings have nutrients and a greatly increased microbial life of between two and five times that of ordinary soil mixes. This makes them a high-value substance. Worm castings placed in the middle have plant-available nutrients at least five times more than those found in common potting soil mixes. Scientific analysis of castings has shown that they contain five times more available nitrogen, seven times more available potash, and 1.5 times more calcium than 15 cm of good topsoil. Besides, the life of the nutrition range extends up to 6 times in comparison with any other type of potting mixes.

7.5 SOIL PHYSICAL MODIFICATIONS FOLLOWING VERMICOMPOST APPLICATION

Many processes which might have been conducive to these enhancements of growth, development of crops, and certain yields were allowed to take place because of vermicompost. Each of them might have occurred in greenhouse potting media or in the field soils which were substituted or amended with vermicompost. Physico-chemical and Biological properties of the planting media or the field soils are enhanced due to the vermicompost addition. On the other hand, pH changes were not evident as in the documented shifts by Tyler et al. (1993) who noted increases in substrate pH with increasing rates of composted turkey litter applied to amend a plant container medium. Electrical conductivity of the pig manure vermicompost increased linearly with increasing salt concentration. Soil N, P, and K levels were significantly increased with vermicompost incorporation.

Vermicompost treatments significantly increased organically carbonic, pH, bulk density, and soil porosities, along with microbial populations and dehydrogenase activity [30].

7.6 BENEFITS OF COVER CROPS

Cover crops are known to help build the features of the soil, hence the health of the soil, just as their contribution helps in the lands to improve their crop output. Therefore, if not using cover crops to cover the soil in no-till crop production systems, it would be a very good thing because it would optimize on the economy of nitrogen, use less water in the soil, controls the way at which water from rain is lost and soaked in to the soil, improve the physical characteristics of the soil, increase nutrient and mineral uptake, increase the level of soil fertility, help in suppression of other plants, reduces the effects of diseases and insects, reduces the potential of global warming, and improves the level of yield from the crops. The next section describes the cover crop benefits in depth with soil management.[31]

7.7 ORGANIC NITROGEN MANAGEMENT

Manures are the second most important source of nutrients on farms. Manure from different countries and even different localities in the same country will have different nutritional contents. The nutrients in manure depend on razing systems - farming methods on one hand and varied crops and cattle feeds on the other. Estimation of the loss of nutrients in manure shows at least 50% is lost in the storage and transport stage and further 25% is lost following application. Development research with composted poultry manure has shown a slow release pattern of inorganic nitrogen with a mineralizing part from the whole nitrogen of 0.4–5.8% over 56 days, against 25.4–39.8% in uncomposted poultry manure. Through applying manure with different levels of moisture-holding capacities (e.g., composted), it is regularly proven to increase the activities of soil microbes and thus raise soil fertility, delivered through the enhancement of soil structure. Furthermore, humic substances had been reported to have auxin-like activity in the past, influencing plant physiology toward increased nutrient acquisition in several studies by García et al. Simultaneously to this, flow-through colorimetry has also led to the reveal of the nitrate adsorption on humic substances increasing the availability of nitrogen to the plant. The inputs into crop soil can thus be estimated in terms of nitrogen to determine the quantity of excess nitrogen application the land experiences. The uptake of nitrogen by crops can be taken to be a sign of an excess input of nitrogen, the grasses including. This can be done in a large area of agricultural land within the study region. This can be referred to as the nitrogen balance at the surface as a process of finding the excess nitrogen delivered to the agricultural land. It can give area-wise surface indication where nitrogen pollution is likely to take place under a variety of environmental conditions. The trend of these surpluses can also give effect of agricultural-environmental policies to be taken place to prevent nitrate pollution. On the other, the current surplus estimation continues to suffer that it still cannot be directly read as an indication of nitrogen loss in water. The input-output balance school of thought in system includes all the potential losses. Table 1 reviews those listed in the prior sections as well as nitrogen inventory adjustment to a big degree in the soil. [32]

Soil organic matter content is a principal constituent that gauges physical, chemical, and biological influences of the soil and affects crop yields, hence profitability to the farmers. This gives properties such as bulk density, porosity, available waterholding capacity, capacity 202 of cation exchange, oxidation-reduction potential, and a pH. Organic matter, besides affecting soil properties, provides a source of organic nitrogen for decomposition. The temperature, the levels of oxygen, water content, and pH, among other conditions, all have used in the formation of effect on nitrogen cycling. Critics say it is then the result crops are not able to access is all the of whole of soil organic nitrogen content. It is for this reason that Parton et al. (1987) classified organic material to be attributed to pools in an organic carbon dynamic in an ecosystem and residence time of organic carbon: active, slower, and passive pools. The active pool is the living fraction of microorganisms, products, or easily decomposable SOM that turns over within 1–5 years. The postulated slow pool is physically protected and generally simply more resistant to degradation than the active pool. Its turnover time lies between 2 to 4 decades. This is a substantive jetting including time constraints, with 70 to 75% of the inorganic nitrogen in the soil organic nitrogen, being determined (Cambardella and Elliot, 1992).

Recent soil data from six soils across a range that spanned from Alberta to South Carolina have non-hydrolyzable C, the laboratory measure of recalcitrant C, ranging from 35 to 71% in silt fraction (average). In addition, non-hydrolyzable nitrogen retained in these soils ranged from 32 to 57% (average = 45%) for the clay fraction and from 26 to 62% (average = 36%) in the silt fraction. Modeling appears more feasible especially in analyses requiring long time periods when quantifying SOM and soil organic nitrogen effects on processes like nitrogen mineralization, nitrogen cycling, NUE, and NO3 leaching. Long term studies with 15N confirm the concept of nitrogen retention in many pools and show that soil organic nitrogen is more stable and better "protected" when associated with the clay fraction 7. It should be remembered that nitrogen cycling is a continuing process and in general soil organic nitrogen is rarely stable. This will eventually enable control over much of the components within the nitrogen cycle in accordance with both input levels of nitrogen and cultural practices, patterns of nitrogen intake, and crop nitrogen intake.[33]

VIII. CONCLUSION

In the end, this review paper brought light on the influence of organic manure on greenhouse tomato growth. This study emphasizes the importance of sustainable agricultural methods in modern farming by combining data from over 65 research papers, 33 of which were selected for a comprehensive review. The results emphasize the ability of organic manure to improve soil health, increase crop output, and advocate environmental sustainability in greenhouse structures. However, it is clear that further research is required to fully understand the complexity of organic nitrogen management and its implications for greenhouse vegetable production. The use of protected farming techniques, particularly in areas with limited agricultural resources, is a promising alternative for boosting food security and economic development. Moving forward, interdisciplinary collaboration and ongoing research into innovative farming practices will be key to addressing global food supply concerns and ensuring agriculture's sustainability for generations to come.

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