

Enhancement of Soil Fertility Using Natural Fiber-Based Engineering Composite Materials for Higher Crop Production: A Review Paper

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Abstract:

Enhancement of Soil fertility using engineering composite materials via efficient nutrient management strategies is essential as is rising natural fiber based composite material crop production every land area unit to satisfy next diets and fiber consumption. Major developments have improved the production's nutrient-use economy Improved crop flexibility to applied nutrients, decreased off shore nutrient move, and greater predictions of the nutrients available to plants in the root zone have all been required for agriculture. Thirty articles that improve the Understanding of interconnected Soil, crops, and management components essential to improving crop regrowth and nutrient availability of used fertilizers are featured in the current issue of Monitoring. Adequate Soil material Fertility for Improved Crop Production. Improved nutrition management demands an understanding about the complex interactions special for the particular site such as nutrient rate, source, timing, and position. The ability to estimate soil material nutrient reserves is now greater as an outcome of recent scientific findings on soil material and nutrient management that were discussed in this articles. Various composite materials have been produced using natural fibers through adapted synthetic techniques, broadening their potential applications from automotive to biomedical sectors. Sisal, coconut, eucalyptus pulp, jute, bamboo, malva, hemp, banana, pineapple leaf, ramie bast, kenaf bast, flax, sugarcane fiber, date palm, and cotton are commonly utilized as natural reinforcements in polymer composites to enhance desired properties.

Keywords: Composite materials, minerals cycling, rhizosphere, nutrient use efficiency, Soil composite material testing.

INTRODUCTION

Since that time the almost every inch of the land on planet Earth that is perfect for farmer's land. It's being produced at present time, boosting the quantity produced by plants per unit of land area is going

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to be necessary in order to satisfy demand for sustenance and fiber in the future. The 21st century individuals a threat to Our capacity to serve our protein. In addition to fiber requirements because of anthropogenic land degradation, with in excess of fifty percent of the earth's soils degraded and up to to be 70% in certain regions. [1-5] The utilization of natural fibers as reinforcing agents for polymer composites is progressively increasing in engineering applications. Various composite materials have been produced using natural fibers through adapted synthetic techniques, broadening their potential applications from automotive to biomedical sectors. Sisal, coconut, eucalyptus pulp, jute, bamboo, malva, hemp, banana, pineapple leaf,

ramie bast, kenaf bast, flax, sugarcane fiber, date palm, and cotton are commonly utilized as natural reinforcements in polymer composites to enhance desired properties. The mechanical properties of cellulosic fibers are influenced by factors such as specific gravity, length, diameter, processing techniques, and treatment, which play a significant role in determining their potential applications. Additionally, there are several underexplored fibers like henequen, esparto, hibiscus sabdariffa, sabai grass, and pines, which possess significant potential in terms of thermal resistance, chemical constituents, and mechanical properties comparable to bamboo, hemp, jute, and oil palm fibers. Construction materials and techniques focus on enhancing the functional properties of glass, steel, concrete, and wood, which are fundamental for construction purposes. They offer cost-effectiveness compared to composite materials, especially when a significant proportion of fibers is employed, as opposed to steel fibers. The incorporation of natural fibers in construction promotes a more environmentally friendly, sustainable, and intelligent approach compared to polymer, steel, or synthetic fibers.

Class I–III arable land causes up only 11% of the surface of the earth, currently it will be necessary to keep a 50% increase in produce from agriculture to be able to feed generally 9.5 billion people for the time period 2050. [1] The impacts of land degradation refer to both on-site (like Soil material erosion) and outside (things like as sediment deposition) degradation. Chemical or physical (crusting, compaction, erosion, along with desertification) a rise in acid, biological processes (carbon oxidation/loss, microbial biodiversity) and factors related to the environment (leaching, salinization, fertility depletion). represent the impacts in The yield of crops being an effect of on-site land degradation.[2] Surface water eutrophication, contamination of groundwater, and atmosphere Each trace gas emission (CO₂, CH₄, N₂O, NO_x) must consider overall off-site impact under effect. Soil material fertility and the ability of crops for development are also affected by the physical, chemical, and biological features of Soil material which are affected by on-site Soil material decomposition processes. use vitamins and minerals. It is important to understand these interactions and processes with the goal to improve plant nutrient availability as well as minimize the environment. Nutrient losses. The nutrients in the Soil material are reduced when Plants are raised from the ground or due to particles of Soil material are moved for a new location.[3] The ability for the Soil material to absorb the nutrients dropped from crop removal defines the quantity of minerals present in native soil. Therefore, to ensure needed Soil material nutrient supply management involving inorganic and organic nutrient inputs (nutrient management) and a knowledge of the relations and processes that produce nutrients in soils (Soil material fertility). This is required to increase crop nutrient supply while decreasing environmental risk related to nutrient use. Applying plant- and soil-management methods is important for improving crop production while minimizing the degradation of Soil material productivity caused by nutrient depletion, runoff, and leaching. is suggested to agriculture. Developing reducing nutrient depletion while boosting crop recovery of applied nutrients to outside conveyance is necessary. due to fertilizer demand has increased (in excess of food demand). [4-9] In order boosting research studies to: (1) evaluate the ability for the Soil material to supply nutrients; (2) improve crop management practices and plant genetics; or (3) improve nutrient-management technologies, implementing consideration of the sources, rates, or destinations. and timing of vitamins and minerals, is required to improve nutrient availability and nutrient use productivity. The following sections give an extract of 15 manuscripts focusing on soil, plant, and management components which are necessary for the growth of applied crop recovery nutrients and nutrient availability.

PLANT-RELATED ELEMENTS

Increased nutrient metabolism in the plant, changes to plant genetics, particular in consider to root structure, and the effects of root exudate on rhizosphere biochemistry may assist plants consume nutrients from the Soil material more successfully [6-8]. For example, it has been discovered that genetic variation takes place within and between plant species discovered in the quantity organic acids which flow out towards the root system. increases Soil material P solubility and mobilization, consequently increasing P use efficiency [7]. Additionally, given that the exudation of the growing of transgenic plants in the rhizosphere that have a greater phytase concentration may enhance P

mineralization and P consumption. Phytase enzyme by plant roots is genetically managed [8]. In this specific variation, Pellegrino et al. [9-11] found that *Rhizoglyphus irregularis* soil material infection at planting improved wheat grain micronutrient uptake, with significant differences through wheat genotypes. Since tobacco was grown in soil, Lisuma and colleagues. [10] observed that P, K, Mg, and S decreased while N and Ca increased. This could have taken place to be an outcome of higher rhizosphere nicotine manufacturing. Along with all of the of our partners. Studied what took place when rice seedlings were immersed in a solution. Which is greater in P before transplanting. What they discovered indicated that seedling biomass and P uptake may increase.

CERTAIN ELEMENTS OF NUTRIENT MANAGEMENT

Rates During Nutrients—Suggestions

Soil composite material testing is required to determine crop nutrient requirements and the power for the Soil material to provide nutrients to ensure farmers are able to effective nutrient management. Over Seeding vegetables with nutrients outcomes in greater residual nutrient reserves that, if not utilized or recovered in afterwards crops, that might require off-site public transport and decrease the state of the surrounding environment [12]. This is especially significant if using waste products from mammals or other types of waste frequently crop N requirements, in addition to the quantity of P and elements given as waste usually exceeds crop demand [16]. Soil composite material testing-based nutrient recommendations are well-established and dependable.[17]. To be able to adequately take into consideration improvements in soil/crop technology for crop management and plant genetics which affect crop nutrient requirements, nutrient recommendation models have to be changed on an ongoing schedule.

Quantitative Evaluation of Tropical Soil material Fertilization, as well as Model QUEFTS was utilized. By Xie or collaborators. [18] Results indicated that the quantity of nutrients deposited improved directly with yield. yields obtained 60 to 70% of the determined yield thereafter., the result was a slight decrease with nutrient construction. Nutrient use efficiency can be greatly improved by accurate equipment capable of quantify nutrient demand in order to minimize over application errors. Li et al. [13-15] Every one performed a meta-analysis that included nearly 300 studies regarding the healthy response of fruit trees covering 40 years. Increasing crop yields have been observed through time, although agronomic efficiency and partial factor productivity for NPK reduced likewise. as a result of greater Soil material nutrient concentrations supply. These results indicate that manufacturing can be maintained despite reduced NPK rates. Dupre or company. [19] Effectively developed Ranges for interpretation for Mehlich-3 extractable B and hot-water in testing for Soil material (low, medium, high) utilizing supplied Soil material analysis data (around 1200 samples) which were local. These results greatly boost ability to determine B deficiency as well as minimize B-toxicity ability. A helpful technique of measuring nutrient requirements for improving the level of accuracy and reliability of nutritional guidance. Song et al. utilized field data. [20] Produced significantly more accurate leaf-dry-matter-N concentration curves that improved accuracy of rice's N nutrition diagnosis.

Sources For Nutrients

It has been verified that making biofertilizers from organic waste material improves the availability of needed nutrients to plants [21]. Vanneekhaute et al [22]. discovered with the goal to boost P use efficiency, biofertilizers provide effective alternatives over inorganic P fertilizers. Based on the latest review on the data, bio-based fertilizers increase crop flexibility about 8–22%.[23] Animal and bio solid wastes provide important supplies for fertilizer used in agriculture recycling as the global population increases. For example, it has been known to successfully produce struvite ($\text{MgNH}_4\text{PO}_4 \cdot 6\text{H}_2\text{O}$) from a number of wastes, which produces an efficient slow-release P fertilizer.[24]. In addition, it was observed a component of once mixed with rock phosphate, when compared to rock phosphate alone, composted plant foods that remain and animal waste materials improve the quantity and productivity of P usage in soils that have elevated the acidity [25]. as well as [26]. compared NPK-containing super granules to organically enhanced N fertilizer and observed little variations in corn-grain quality parameters between the two food sources. While being technically accepted as an important plant

nutrient, Gad et al. [27] Research has shown that feeding a copper to seeds developing in semi-arid soils increased levels about *Moringaoleifera* Lam yield, growth, and plant copper, and particularly when paired with animal wastes. [28] Shown that utilizing slow-release fertilizer improved yield and the resulting profit when applying chives to be nutrition while reducing the NPK rates necessary for maximum yield. Aslam & the Company. [29] Researchers discovered that high levels with *Moringaoleifera* Lam production of cells, growth, and plant adding NPK + vermicompost, as compared to NPK alone, increased wheat crop yield and production components. Głowacka et al. [30] Researchers reported that adding biogas digestate together with recommended fertilizer significantly improved the soil's pH level, switchgrass, organic matter, and cation exchange the ability manufacturing of the ground. Based on these results, recycling organic waste materials improves both the chemical and physical features of soil, supporting the growth of crops and nutrient availability. Han or other people. [31] Determined that after several years on recovering all corn and rice waste products to the soil, there had been significant improvements in Soil material biological matter (OM) and a number of other important metrics, resulting to greater yields while alternating between maize and rice. Wang or partners. [31] Analyzed mulching's effect upon potato efficiency and nitrogen utilization rate (NUE) in dry areas through a meta-analysis of 169 field tests. The results showed that mulching greatly raised yield and NUE; on the other hand, mulching in addition to organic fertilizers significantly reduced NPK fertilizer input without affecting NUE or potato production. Although this has little related to providing vitamins and nutrients, it is important for maintaining the chemical properties of the ground at levels suitable for the greatest yield. Considering Sakai et al. [32] applied a combination of organic waste materials and low-quality coal to sodic soils with the goal to increase exchangeable Ca^{+2} eventually leading to the production of maize while significantly reducing the amount of exchangeable Na and Soil material pH.

TOXIC ENVIRONMENTAL POLLUTANTS

Several different types of pollutants, specifically contaminating the soil, relate to environmental disease. They include the most hazardous chemicals which are harmful to the air, water, and soil. These include just a few of the most hazardous pollutants. Discovered in soil.

Food Scraps

A society's limitless assets are increasing stress as the demand for food increases in parallel with population development and income levels, demanding increased supply.

From [32] There may be 9 billion people on planet Earth by 2050, based on estimations, which will raise the requirement for food. Based on experts, to be able to sustain the increasing world population, 15% more agricultural production will be required that would result in 5% additional food [33]. Food disposal must be done to generate biogas and minimize damage to the environment [34] to decrease the amount of trash discharged in landfills and the harm that it causes to the environment, FW has to be properly handled. FW is challenging since it reflects a drop in the amount of goods (such water and power). From the point of view of the EWF nexus, it analyzes where food, energy, and water interact, in addition to FW management takes an essential role. The ones that follow are pyrolysis by products:

The main cause of micro pollutant growth is the release of multiple medicines from drug manufacturers and hospitals, include pharmaceuticals which minimize inflammatory conditions, analgesics, antibiotics, and painkillers. Acetylsalicylic acid, carbamazepine, ciprofloxacin, ibuprofen, paracetamol, and tetracycline are a few essential pharmaceutical chemical compounds. Biodegradation-resistant or transport proteins of radioactive elements, causing the formation of microbes resistant to antibiotic.

Pesticides

For controlling Researchers developed insecticides are used to kill unwanted organisms which include bacteria, insects, or weeds. The four frequently utilized types of pesticides are carbamates, organochlorines, pyrethroids, and organophosphates. Some pesticides may function successfully

against the organisms there're designed to eliminate, but they can also have adverse effects. Negative effects on things that don't exist during 2006, Karoly and Ruehlman Persistent organic pollutants (POPs), that are capable of remaining in the environment for years due to being resistant breakdown the environment, are a usual part for pesticides. Industry-transmitted chemical substances are hazardous for humans or fish species. Any kind of herbicide destroys plants, decreasing the quality of oxygen in the air which makes it hard for fish to breathe accurately. Pesticides were subsequently discharged into the environment. As a consequence of volatilization results in [35].

Negative impacts on the purity in air quality. Pesticides which get to the earth can have adverse impacts on groundwater, Soil material fertility, and plant growth.

Pesticides may pass through the human body through the digestive system, lungs, and skin. A great deal of skin contamination comes during spraying and mixing pesticide [36] Consumption of aerosolized pesticides induces oxidative stress in humans. Herbicides including organ phosphorus may additionally cause chromosomal abnormalities and cancer [37] therefore, it's essential to take steps to reduce it reduce pesticide use while investigating for alternatives that are less expensive.

Heavy Metals

Any element containing a density in excess of 4000 kg/m³ is referred to as a heavy metal (HM). Lead, chromium, cadmium, copper, cobalt, zinc, and zinc compounds include examples of these heavy metals [38]. Heavy metals such cobalt, copper, and zinc are necessary for various functions in biology. However, adverse environmental impact arises when concentrations above safe thresholds [38]. Arsenic (As), selenium (Se), and additional light transition metals make up these. Aluminum (Al). Here are two groups of heavy metals: those that are hazardous even at high concentrations and those that are required for life but may be harmful in low amounts [39]. The identification for heavy metals in the earth's crust has been made available by scientific research. Further impacts from nature involve Soil material erosion, geological weathering, volcanic eruptions, and the loss of metals because of evaporation [40] nonetheless have been an important increase in heavy metal emissions based due to human activities includes transportation and mining of metals. They may have more impact on ecosystems compared to contamination of the soil. Plant tissues absorb hydrocarbons, which could hinder growth and decrease biomass growth. HMs develop in human bodies and create disease.

Through an amount long time, numerous organs operate. Lipid oxidation develops at the cell surface when Cu, Fe, and Zn levels increase over appropriate thresholds [41-42]. The redox balance and variations in pH becomes disrupted when the body includes a large quantity of H⁺ ions. Proteins change is the result, and cells death. Free radicals are the root causes for oxidative stress and skin damage. These additionally result in bone disintegration, blood and liver problems, kidney damage, and calcium loss. A decline in both hemoglobin and HDL cholesterol levels.

Municipal Solid Pollutants

Whenever a sanitary landfill gets sealed off from the earth, water typically dries from the dumped garbage or enters as precipitation. Scientists annually monitor the number and nature of leachates at the forces closest the entry of the protected lake. The amount of leachate in the subject of investigation area is influenced by the total amount of rainfall. Leachates should be cleaned out correctly due to according to multiple study, they can be hazardous to the environment [40]. According to Alnahas contamination of waste management facilities presents problems to the health of the planet, as it may spread to the landfill and the groundwater demanded by the crops in the surrounding agricultural areas. Due to their specific make-up, leachates and groundwater be difficult to prepare for toxicity; yet, physical-chemical investigations indicate that many kinds of environmental issues are triggered through landfills. In accordance with the study by [47] toxicological research need to center on the leachates' cumulative impact on harmful substances. Multiple methods to investigating and making use of germs may be required in different environments, such residential and commercial properties, and manufacturing facilities, and also in developed and developing countries.

Pharmaceutical Wastes

Drugs have to be made to protect the well-being of all people. Small amounts of regular pharmaceutical utilization are disposed of through hospitals, farms, houses, and drug manufacturers. Expires, and the discharge of rubbish into the environment which severely [43].

It's as just unknown exactly All surrounding non-target components are affected with pharmaceutical active ingredients (API). Due to limited broad data and increasing medical expenses, unwanted medicines are disposed of improperly, causing in unplanned injury. Bacterial mortality, landfill contaminating things, and antibiotic resistance [44]. Since harmful levels of drugs do not always follow with the approved harmful dosage curve, consuming poisoned amounts of the drug might prove dangerous [45]. Particularly dangerous are chemicals that disrupt the endocrine system (EDS), as even low levels may cause adverse effects for humans within addition to the animals. During flight combustion burning biological material the ash contains several types of dangerous substances that don't usually follow the usual toxic dosage curve, it is referred to as hazardous waste [45]. Such these are carcinogens and furans, along with dangerous organic pollutants that can leach out, like alkali chlorides [46]. The intake of prescription drugs supplied over-the-counter and the manufacturing of multiple drugs are all linked to a rise in biological waste in the health care industry as the number of patients and consumers rises [38, 47]. The arrival to different pharmaceuticals, like analgesics, antibiotics, sources and consequences of toxic compounds are discussed in Table 1.

Table 1. List the main toxic compounds and their consequences for the environment.

Ref. No.	Pollutants	Sources	Effects
[48]	Heavy metals	Anthropogenic interactions between people Mining companies that generate waste through manufacturing Techniques of Combustion Potential damaging effects of landfills	The generation for reactive oxygen species (ROS) rises. Effects of Soil material fertility arise. The microbial processes in the Soil material microbiota are impacted.
[49]	Dyes	Waste water of textile manufacturing Paint industry waste The pulp or newspaper manufacturing pharmaceutical byproduct from the manufacturing process of papers	Marine life thus receive less oxygen, and water bodies lost part of its clarity. Respiratory problems and allergic reactions develop.
[50]	Pesticides Herbicides	Production of insecticides Agriculture utilizes technology Pesticides hadn't been disposed of. Treatment of wastewater plants runoff after precipitation	Decreases the quantity of Soil material organisms present It reduces zooplankton form water bodies and have an impact on the organisms that live there.
[51]	Plastics	Containers and bags comprised of plastic Food putting Straws and stirrers plastic bottles with drinking	Allows environmental greenhouse gases escape. Chlorinated plastics damage Soil material integrity and the quality of groundwater.

CONCLUSIONS

No matter where they come from, fertilizers applied more quickly than crops are removed eventually leave behind more residual applied nutrients and have the potential to be transported into the environment.

Improved nutrition management demands an understanding about the complex interactions special for the particular site such as nutrient rate, source, timing, and position. The ability to estimate soil material nutrient reserves is now greater as an outcome of recent scientific findings on soil material and nutrient management that were discussed in this articles. To improve nutrient availability and promote crop and soil material efficiency; Controlling soil material fertility for higher crop production is necessary.

Author Contributions

Help in the modifying work, creating this editorial, and special issue organizing. After reviewing the published version of the manuscript, every author provided their approval.

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Conflicts of Interest

None of the conflicts of interest have been disclosed by the author

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