



# International Journal of Engineering, Science and Humanities

An international peer reviewed, refereed, open access journal

Impact Factor: 8.3 [www.ijesh.com](http://www.ijesh.com) ISSN: 2250 3552

## **Effect of Organic Fertilizers on the Growth and Yield of Crop Plants**

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### **Abstract**

The present study analysed the effect of organic fertilizers on growth and yield of crop plants. Organic fertilizers are plant, animal and microbial-based forms of fertilizers, such as farmyard manure, compost, vermicompost, green manure, biofertilizers and crop residues. These fertilizers due to their ability to increase organic matter, improve soil structure, water holding capacity, and beneficial microbial activity, enhance soil fertility. The organic fertilizers release the nutrients slowly and continuously as compared to chemical fertilizers and hence the plant absorb the nutrients according to its need and thus there is no loss of nutrient during leaching and run off. They supply essential nutrients such as nitrogen, phosphorus, potassium, calcium, magnesium, sulphur and micronutrients that are necessary for seed germination, root development, shoot growth, leaf formation, chlorophyll production, flowering, fruiting and biomass production. Organic fertilizers also have the ability to enhance soil biological health by promoting microorganisms associated with decomposition, nitrogen fixation, phosphorus solubilization and nutrient cycling. Regular use enhances the crop growth, yield quality, grain size, fruit weight and productivity. Besides, organic fertilizers decrease the reliance on chemical fertilizers, reduce and prevent environmental pollution, recycle the agricultural waste and promote sustainable agriculture. So, the use of organic fertilisers is crucial for ensuring the soil's long-term fertility, and for enhancing crop productivity and sustainable farming.

**Keywords:** Organic fertilizers, crop growth, crop yield, soil fertility, sustainable agriculture, farmyard manure, compost, vermicompost, green manure, biofertilizers, nutrient supply

### **Introduction**

Agriculture is a very important part of human life as it provides food, raw materials, employment and economic support to a large part of the society. A multitude of factors, including the fertility of the soil, the availability of the soil nutrients, water, climate, quality of the seed and farming practices, influence the growth and yield of crop plants. Soil fertility is one of the major factors among these as plants take nutrients from the soil to grow and develop. But the natural fertility of the agricultural soils have been reduced due to continuous cultivation, over-fertilisation with chemical fertilisers, soil erosion and reduction of organic matter. So, farmers and researchers are now focusing more on sustainable ways of crop production. Organic fertilizers are among the best organic methods to enhance the fertility of soil and boost the production of crops in an eco-



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friendly way. Organic fertilizers are naturally derived materials from plant, animal and microbial sources. They are farmyard manure, compost, vermicompost, green manure, poultry manure, biofertilizers and crop residues. They contain various essential nutrients like Nitrogen, Phosphorous, Potassium, Calcium, Magnesium and micronutrients to plants. The nutrients released by organic fertilizers are slower than that of chemical fertilizers. Slow release allows plants to absorb nutrients as needed, and minimises nutrient leaching. Organic fertilizers not only provide crops with nutrients, but also are capable of enhancing the physical, chemical and biological characteristics of soil. Organic fertilizers are beneficial to the health of the soil. They help to build up soil organic matter, improve soil structure, increase water holding capacity and improve aeration. Soils with a high organic matter content allow good root growth and allow plants to absorb water and nutrients. Organic fertilizers also stimulate positive bacteria in the soil. These microorganisms help in decomposition of organic matter, nutrient cycling, nitrogen fixation and phosphorus solubilization. This helps to improve the fertility of the soil and makes it better for growing plants.

Organic fertilizers have direct effects on the growth of the crop plants. They enhance seed germination, root development, shoot growth, leaf growth, chlorophyll content and photosynthetic activity. Healthy root system will allow plants to uptake more nutrients and water from the soil. With increased leaf area, plants can produce more food in their bodies (photosynthesis). This enhances plant height, biomass production, flowering, fruiting and seed formation. Hence organic fertilizers are beneficial for both vegetative and reproductive growth of the crop plants. The yield response of crops to organic fertilizers is also important. There may be an improvement in yield quality, grain size, fruit weight, number of flowers, fruits and productivity with crops fertilized using organic fertilizers. Organic fertilizers are less immediate than chemical fertilizers, but they have more lasting effects. Over time they add fertility to the soil and contribute to soil productivity for future crop seasons. Organic fertilizers also decrease the usage of chemical fertilizers, pollution of the environment, and favor sustainable agriculture. Balanced use of Organic Fertilizers is of great importance in the present Agriculture system. The food production demand is rapidly increasing with rising population. Meanwhile, over-fertilization with chemicals has caused soil deterioration, water pollution, decrease in soil microbes, and poor crop quality. Organic fertilizers are a natural and eco friendly answer to these issues. They help maintain soil fertility, improve plant growth, increase crop yield and protect the environment. Hence, the research into the effect of organic fertilizers on the growth and yield of crop plants has become more significant in the knowledge of its effect in the sustainable production of crops and long-term agricultural development.

## **Organic Fertilizers: Meaning and Types**

The substances used to provide nutrients and that are of plant, animal and microbial origin are called organic fertilizers. Their use is for enhancing the fertility of soil and supplying slow and



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continuous supply of nutritional requirements to the crop plants. Organic fertilisers are not generally soluble in water, but slowly release nutrients through the work done by soil microorganisms. They are rich in primary (nitrogen, phosphorus and potassium) nutrients, secondary nutrients and micro nutrients which are required for healthy plant growth. The fertilizers also benefit the physical, chemical and biological properties of the soil. They help to improve soil structure, aeration, water-holding capacity, soil organic matter and beneficial soil organisms. Therefore, organic fertilizers are not only a source of plant nutrients but also an important means of maintaining long-term soil health and sustainable crop production. Farmyard manure is the most ancient and generally used organic fertilizer in agricultural use. Made from the urine and faeces of cattle, food waste, bedding material and other farm waste mixed together and broken down. Farmyard manure provides balanced and natural source of nutrients to soil. It has less nutrient value than chemical fertilisers, but it is of great significance to contribute to the soil's fertility in the long term. It helps to add organic matter to soil, enhance soil texture, boost microbial activity and helps to retain soil moisture. When farmyard manure is applied regularly, it makes the soil loose, porous and suitable for root growth. It also decreases soil hardness and increases the ability of the plants to uptake nutrients. Farmyard manure is found to be particularly effective in improving the productivity of soil in traditional farming and organic farming.

Another significant organic fertilizer that is obtained by decomposing organic wastes like crop residues, leaves, weeds, kitchen wastes and animal wastes and other biodegradable materials is called compost manure. The microorganisms decompose the organic matter and produce a dark-colored crumbly and nutrient-rich product called compost. Compost manure not only adds more organic carbon to the soil but also provides essential nutrients. It not only improves the soil structure but also helps in retaining water and making it more available for the plants. Compost also plays a role in cutting down agricultural and household wastes through the process of transforming it into useful manure. It is thought to be environmentally friendly as it is able to recycle the organic wastes and chemical fertilizers are not so much used. Compost that is prepared properly is safe for the crop and promotes good plant growth. Vermicompost is an excellent organic manure generated by the activity of earthworms on organic wastes. Earthworms eat organic matter and turn it into small, rich in nutrients castings. Vermicompost has all the essential nutrients, growth promoting substances, enzymes and beneficial microorganisms. It is superior to normal compost as it makes nutrients more available and it stimulates plants to grow. Vermicompost enhances the germination of seeds, development of roots, growth of leaves, flowering and fruit formation. It also boosts soil micro-biological activity and improves the biological fertility of soil. Vermicompost is popular in vegetable crops, fruit crops, ornamental plants and organic farming because of its fine texture and high nutrient levels. It is regarded as one of the most effective organic fertilizers both in crop growth and crop quality. Any plants used to produce green manure are those planted with the specific purpose of being added to the soil before



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the flowering or maturity stage. Usually by these crops are plants that grow swiftly like sun hemp, dhaincha, cowpea, clover and other leguminous plants. The green manure crops are ploughed before they become mature. They decompose and leave organic matter and nutrients in the soil. Leguminous green manure crops are particularly beneficial because they sequester nitrogen from the air with the help of nitrogen-fixing bacteria, within the root nodules. This helps to provide more nitrogen for the soil and less synthetic nitrogen fertilizers. Green manure also improves soil structure, prevents erosion, suppresses weeds and enhances microbial activity. It is highly beneficial for rehabilitating soils and for ensuring sustainable agriculture.

Biofertilizers are the living microorganisms which are applied to the seeds, soil or plant roots and make nutrients available to plants. They contain beneficial bacteria, fungi and algae which promote nutrient cycling and plant growth. Examples of biofertilizers are Rhizobium, Azotobacter, Azospirillum, phosphate solubilizing bacteria, mycorrhiza and blue-green algae. Rhizobium is used for nitrogen fixation in leguminous crops and Azotobacter and Azospirillum promote nitrogen supply in non-leguminous crops. Phosphate-solubilizing bacteria convert insoluble phosphorus into plant available form. Mycorrhizal fungi increase the absorption of phosphorus and enable plants to withstand drought and stress. Biofertilizers are environment friendly, economical and effective in increasing soil fertility without the use of chemical fertilizers. They indirectly contribute less manure in volume but enhance the biological processes to make nutrients available to plants. Crop Residue Organic Manure is a manure that is created from the plant materials left over after the crops have been harvested. These remaining products consist of straw, stalks, leaves, husks, roots and other plant material. Crop residues can be broken down and used as organic manure instead of being burnt. Crop residues contain high amount of organic carbon and can enhance soil fertility if returned to soil. They add organic matter, help to build soil structure, hold soil moisture, and feed soil microbes. The decomposition of crop residues releases nutrients gradually and helps maintain soil fertility. Crop residues as organic manures also help in minimizing air pollution by stubble burning and encouraging recycling of the residues in agriculture. It is a good practice in sustainable agriculture as it makes use of agricultural waste as a source of plant nutrients. In general, the use of organic fertilizers like farmyard manure, compost manure, vermicompost, green manure, biofertilizers and manure made from crop residues has good effect on improving soil health and crop productivity. They serve as sources of nutrients, condition soil, enhance microbial activity and promote sustainable agriculture. Their regular application helps maintain the soil fertility in the long-term and mitigates negative impacts of over-fertilization with chemicals.

## **Nutrient Supply through Organic Fertilizers**

Organic fertilizers are also a significant contributor to providing the plant nutrients in an organic and sustainable way. They are prepared from plant residues, animal excreta, compost, vermiworm compost, green manure, organic contents and biofertilizers. The fertilisers contain all the essential



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nutrients (Nitrogen, Phosphorus, Potassium, Calcium, Magnesium, Sulphur, Iron, Zinc, Manganese, Copper and Boron). Organic fertilizers do not release the nutrients in a big quantity as soon as administered, unlike chemical fertilizers. Instead, they break down slowly in the soil with the help of microorganisms, release nutrients slowly as per plant requirement. This continuous and slow release of nutrients ensures proper cultivation of crops for a longer duration and minimises nutrient loss. One of the major nutrients supplied by organic fertilizers is nitrogen. Nitrogen plays an important role in the growth of plants, like in leaf formation, production of chlorophyll, protein synthesis, and in overall growth of the plant. The organic fertilizers like farmyard manure, compost, green manure, vermicompost and biofertilizers are sources of nitrogen to the soil. Nitrogen fixing bacteria found in root nodules of leguminous crops utilize the nitrogen from the air for the benefit of the crops; this is done by green manure crops, particularly leguminous plants. Mixed in the ground, these crops break down and release nitrogen. This enhances plant height, leaf area, stem growth and biomass production. Correct nitrogen level, using organics, produces healthy green plants. Other essential nutrients provided by organic fertilizers are phosphorus. It is critical for root development, seed germination, flowering, fruit formation and energy transfer in the plant. Organic matter can convert unavailable phosphorus in the soil to available forms that plants can absorb. Sources of phosphorus are compost, vermicompost, bone meal and phosphate solubilizing biofertilizers. More phosphorus is available, the more vigorous the plant's roots will be. The deep root system of crops ensures greater uptake of water and nutrient uptake from the soil. This results in better early growth, flowering, seed setting and crop yield. Organic fertilizers also provide potassium that is needed by crop plants. Potassium helps in enzyme activation, water regulation, disease resistance, photosynthesis and quality improvement of crops. It strengthens stems, increases drought resistance and stress resistance in plants. Potassium availability can be enhanced in soil by the use of organic fertilizers (compost, crop residues, farmyard manure and plant ash). Sufficient potassium promotes good grain filling, fruit size, sugar content, quality and overall productivity. It also aids in the maintenance of good growth in adverse conditions, such as high temperatures and water stress, as well as the attack of diseases.

Organic fertilizers can also provide secondary nutrients and micronutrients which are needed in smaller quantities but are of high importance for healthy plant growth. Calcium is important for cell wall formation and root growth. Magnesium is an essential part of chlorophyll and required for photosynthesis. Sulphur is involved in protein synthesis and also helps to enhance crop quality. Micronutrients, zinc, iron, copper, manganese and boron, aid in enzyme activity, chlorophyll formation, flowering and seed development. Organic fertilizers tend to contain more nutrients than are found in chemical fertilizers and are generally in a more balanced form than nitrogen, phosphorus and potassium. The available nutrient balance promotes not only the growth of crops, but also their nutritional value. The nutrient supply from organic fertilizers depends on the process of decomposition. The soil contains soil microorganisms like bacteria, fungi, actinomycetes and



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earthworms which help in the breakdown of organic material into simpler forms. In this process nutrients are added to the soil solution and are available to plant roots. The process is referred to as mineralization. The nutrient release rate will vary with the organic material, soil moisture, temperature, aeration and micro activity. Organic fertilizers that are well-decomposed will provide more efficient release of nutrients and will be less harmful to the crops. When organic matter is poorly decomposed, the nutrients may be temporarily unavailable for plant uptake since the microorganisms decompose the organic matter and use nutrients for their growth. Organic fertilizers enhance nutrient-use efficiency as a result of minimizing nutrient losses from soil. Nutrients can be lost from chemical fertilizers due to leaching, runoff, volatilisation or fixation. Organic fertilizers help to minimize these losses as they help to enhance soil structure and the soils ability to retain nutrients. Organic matter is like a sponge and retains nutrients in the root zone for a longer period of time. In addition, it makes the soil more cation exchange capacity and thus, it can hold the important nutrients like ammonium, calcium, magnesium and potassium. This means that the nutrients are taken up slowly and effectively by plants.

Another significant advantage of nutrient supply using organic fertilizers is that soil biology is enhanced. Organic fertilizers feed the organisms of the soil. These microorganisms play a role in the recycling of nutrients, nitrogen fixation, phosphorus solubilization, decomposing organic matter and humus formation. It is a stable form of organic matter which for a long period of time enhances fertility in the soil, termed humus. A living soil continually supplies nutrients and promotes good crop development. Organic fertilizers, therefore, not only provide nutrients directly to plants, but also stimulate soil organisms that help release nutrients. Organic fertilizers also increase the soil's long-term fertility. In the short term, the soil may be able to increase in yield when only chemicals are used, but over time soil health and organic matter levels may be compromised. Organic fertilizers help to sustain soil fertility by increasing the organic carbon and nutrient balance level. They provide a good soil condition for the roots to grow in and absorb nutrients. This results in better germination, root growth, leaf development, photosynthesis, flowering and yield. Thus, the use of organic fertilizers is not only crucial for sustainable agriculture, but also for better crop productivity and soil health for the future generations.

## **Effect of Organic Fertilizers on Soil Health**

Organic fertilizers can have a very positive and lasting impact on soil health as they enhance the soil's physical, chemical and biological characteristics. Soil health is the capacity of soil to grow crops, hold and supply plant available nutrients, hold water, sustain microbial activity and remain productive over time. The addition of organic fertilizers like farmyard manure, compost, vermicompost, green manure, biofertilizers and crop residues in the soil help to raise the amount of organic matter. Organic material is very significant to soil fertility as it contributes to soil nutrient supplies and general soil quality. The more the organic matter in the soil, the more fertile, soft and loose the soil is, and the more suitable it is for the growth of the roots. Organic fertilizers



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have a positive effect on the physical structure of the soil. They increase the porosity of heavy clay soils and decrease soil hardness, promoting good drainage in the soil. In sandy soils, organic fertilizers enhance soil water and nutrient holding capacity. This is essential as sandy soils tend to rapidly lose water and nutrients. Organic matter links soil particles together and creates stable soil aggregates. These aggregates help to break up the soil, prevent crusting, minimize compaction, ensure germination and root growth. A good structured soil is essential so that plant roots can penetrate to a deeper root zone and uptake more water and nutrients.

**Table 1:** *Effect of Organic Fertilizers on Soil Health*

S. No.	Soil Health Parameter	Effect of Organic Fertilizers	Soil Health Improvement Value (%)
1	Soil Organic Matter	Increases organic matter and improves overall soil fertility	88
2	Soil Structure	Makes soil loose, porous and suitable for root growth	84
3	Water-Holding Capacity	Helps soil retain moisture for a longer time and reduces drought stress	82
4	Soil Aeration	Improves movement of air and water in the soil	78
5	Microbial Activity	Promotes beneficial bacteria, fungi, earthworms and other soil organisms	86
6	Nutrient Availability	Releases nutrients slowly and supports balanced nutrient supply	85
7	Soil Erosion Control	Improves soil aggregation and reduces loss of soil by wind and water	76
8	Soil pH Balance	Helps maintain suitable soil reaction and reduces soil degradation	74



**Figure 1:** *Effect of Organic Fertilizers on Soil Health*

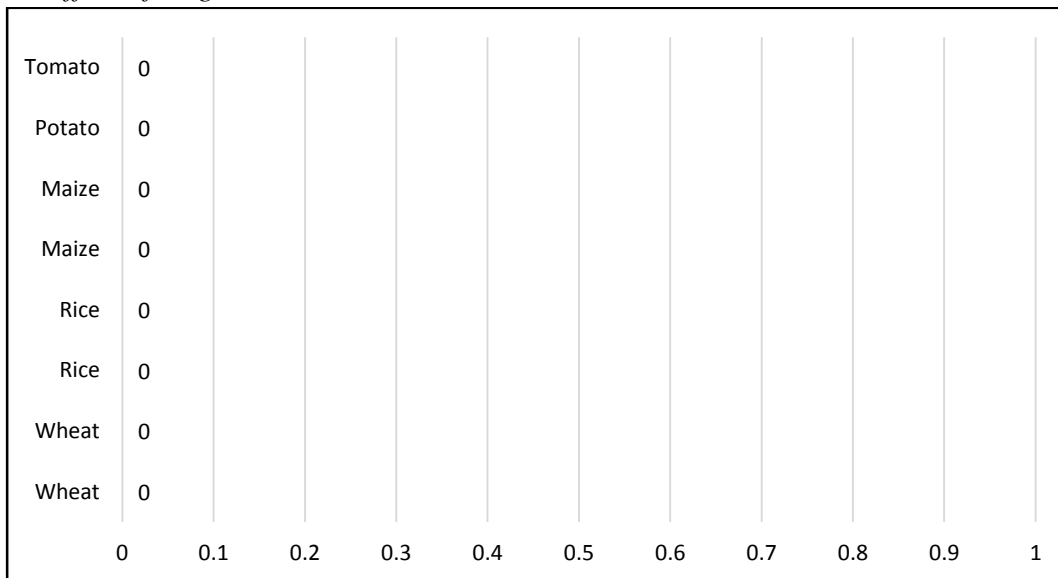


Table 1 shows the effect of organic fertilizers on different soil health parameters. It describes how organic fertilizers are important in soil physical, chemical and biological improvement. The highest improvement value is achieved with soil organic matter (88%), thus demonstrating that organic fertilizers can have a significant positive effect on soil organic matter and hence soil fertility. Organic matter is highly significant in its role of nutrient supply, water holding capacity and improved root system development. 84% improvement soil structure, organic fertilizers loosen the soil, make it porous and proper root development. Favorable soil conditions enables the roots to penetrate with ease and uptake additional water and nutrients. The water holding capacity is improved by 82% due to increased soil moisture retention capacity by organic fertilizers. This helps to minimize drought stress and encourages crop growth under drought stress. The aeration of soil is improved by 78% with use of organic fertilizers, which is an improvement of air and water movement in the soil. Root respiration and microbial activity requires proper aeration. Microbial activity increases by 86% due to the increase in beneficial bacteria, fungi, earthworms, etc. in the soil promoted by the use of organic fertilizers. These organisms aid in decomposition, nutrient cycling, nitrogen fixation and humus formation. Nutrient availability improves by 85% as organic fertilizers release nutrients gradually and plant can access balanced nutrients. The slow release decreases nutrient losses and increases nutrient-use efficiency. Soil erosion control increases by 76%, with the use of organic fertilizers which enhance soil aggregation and help to stop the loss of soil due to wind and water. 74% improvement in soil pH balance as organic fertilizers are used to maintain a balance in the soil reaction and to minimize soil degradation. The table clearly suggests that organic fertilizers are more beneficial to soil health through a combination of increased organic matter, improved soil

structure, better water holding capacity, increased soil microbial activity, improved nutrient availability and protection from soil erosion and degradation. Thus, organic fertilizers play a critical role in the long-term fertility and sustainable crop production and yields.

**Image 1:** *Effect of organic Fertilizers on soil Health*



Organic fertilizers also enhance water-holding capacity of soil. Organic matter has a sponge-like quality that is able to absorb and hold water for a longer period. This will help the crops survive during drought and lessen the frequency of watering. This is particularly helpful in low and erratic rainfall regions. With adequate moisture, plants can carry out their normal growth activities, including the uptake of nutrients and photosynthesis and cell division. In this way, application of organic fertilizers can help alleviate drought stress and ensure good plant health. The chemical fertility of soil is also improved by organic fertilizers. They provide essential nutrients including nitrogen (N), phosphorus (P), potassium (K), calcium (Ca), magnesium (Mg), sulphur (S) and micro-nutrients. These nutrients are slowly released by the breakdown of organic material. This slow release helps reduce the loss of nutrients suddenly and gives a continuous release of nutrients to the plants. Organic fertilizers also raise the cation exchange capacity of soil, so that nutrients will be retained more effectively and be released to plant roots when needed. They help to lower nutrient leaching and increase nutrient-use efficiency. Plants thrive as a consequence, and are also balanced in their nutrition. Organic fertilizers have a strong effect on the biological health of soil.



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They serve as food and energy for the beneficial microorganisms (bacteria, fungi, actinomycetes, earthworms and other soil organisms). They are significant in the decomposition, recycling of nutrients, nitrogen fixation, solubilization of phosphates, formation of humus. Humus is a stable organic matter that can enhance soil fertility for a long period of time. Living soil is a soil that contains microorganisms and is continually decomposing organic matter and releasing nutrients for plant growth. This biotic activity is responsible for increasing the productivity and sustainability of the soil.

Organic fertilizers also contribute to soil pH level maintenance and minimisation of soil degradation. Organic fertilizers may help to maintain a better soil environment by buffering soil reactions from continuous use of chemical fertilizers. They help lessen soil salinity, acidity and nutrient imbalance, to a certain degree. Organic fertilizers also help to decrease soil erosion due to soil aggregation and increased vegetation cover. If the soil particles are tightly compacted, they will be less easily carried away by water or wind. So, on a broader scale, organic fertilisers are a significant contributor to enhancing and sustaining soil health. They promote microbial activity, hold water, add organic matter, improve soil structure and protect soil from degradation, as well as provide nutrients. They are used regularly and increase the fertility, productiveness and sustainability of the soil. Good soil leads to good plants, good plants lead to good growth and good yield. So, organic fertilizers play an important role in sustainable agriculture and long-term crop production.

## **Effect of Organic Fertilizers on Crop Plant Growth**

Organic fertilizers are highly effective and beneficial for the development of crop plants as they supply nutrients in a natural and balanced form. Crop growth consists of germination of seed, root development, shoot growth, leaf development, flowering, fruiting and biomass production. Plants need to be supplied with the essential nutrients, including nitrogen, phosphorus, potassium, calcium, magnesium, sulphur, iron, zinc, manganese, copper and boron, for healthy growth. These nutrients are released slowly and continuously from organic fertilizers like farmyard manure, compost, vermicompost, green manure, biofertilizers and manure from crop residues. This continuous supply of nutrients allows for proper plant growth over a longer period of time and minimizes risk of nutrient deficiency. Organic fertilizers promote seed germination and early plant establishment. Adding organic matter to soil will increase moisture holding capacity, aeration and soil texture. Seed germination requires adequate moisture, air, and soil temperatures. Seed germination is a very critical process; seeds must have adequate moisture, oxygen and a proper soil temperature to germinate. Organic matter rich soil is soft and porous, thus aiding in the emergence of young seedlings. Organic fertilizers also soften soil and activate microbes in the vicinity of seed area. The seedlings are thus stronger, healthier and better able to withstand the early stage of development.



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Root development is greatly improved by the use of organic fertilizers. A healthy root system is necessary for absorbing water and nutrients from the soil. Organic fertilizers help to loosen and structure the soil well, which helps the roots to spread deep and wide. Organic fertilizers contain phosphorus which aids in root formation and root elongation. The presence of beneficial microorganisms in compost, vermicompost and biofertilizers also promote root growth by increasing the nutrient availability. Good rooting enhances plant resistance to drought, as well as uptake of nutrients and subsequent shoot and leaf production. Organic fertilizers also encourage shoot growth, growth height and biomass production. Nitrogen released from organic fertilizers helps in the formation of proteins, enzymes and chlorophyll. Photosynthesis is the process by which plants make their food, and chlorophyll plays a key role in this process. With adequate nitrogen and other nutrient supply, the stems are stronger and leaves are greener, vegetative growth is enhanced. Organic fertilizers also stimulate cell division and cell enlargement that leads to an increase in plant height, stem thickness, number of branches and dry matter production. Organic fertilizers also enhance growth and chlorophyll production of leaves. In plants, the primary organ of photosynthesis is leaves and improved leaf growth will improve food production. Important nutrients that are necessary for the production of chlorophyll are supplied by organic fertilizers including magnesium, nitrogen, iron and others. Soils amended with organic fertilizers can result in plants with larger leaf area, darker green leaves and increased photosynthetic activity. Photosynthesis increases and this results in more production of carbohydrates for growth, flowering, fruiting and seed development.

**Table 2:** *Effect of Different Organic Fertilizers on Crop Plant Growth*

S. No.	Type of Organic Fertilizer	Main Nutrient / Component	Effect on Crop Plant Growth	Growth Improvement Value (%)
1	Farmyard Manure	Nitrogen, phosphorus, potassium and organic matter	Improves soil fertility, root growth, plant height and overall vegetative growth	78
2	Compost Manure	Organic carbon, micronutrients and humus	Improves soil structure, seed germination, leaf growth and nutrient absorption	82
3	Vermicompost	Enzymes, plant nutrients and beneficial microorganisms	Enhances root development, chlorophyll content, shoot growth and biomass production	88



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4	Green Manure	Nitrogen and fresh organic matter	Increases nitrogen availability, improves soil texture and supports healthy plant growth	80
5	Biofertilizers	Beneficial bacteria and fungi	Promotes nitrogen fixation, phosphorus solubilization and better nutrient uptake	85
6	Crop-Residue-Based Manure	Organic carbon and decomposed plant nutrients	Improves moisture retention, microbial activity and gradual nutrient supply	75
7	Poultry Manure	Nitrogen, phosphorus and potassium	Supports quick vegetative growth, stronger stems and better leaf development	84

**Figure 2:** Effect of Different Organic Fertilizers on Crop Plant Growth

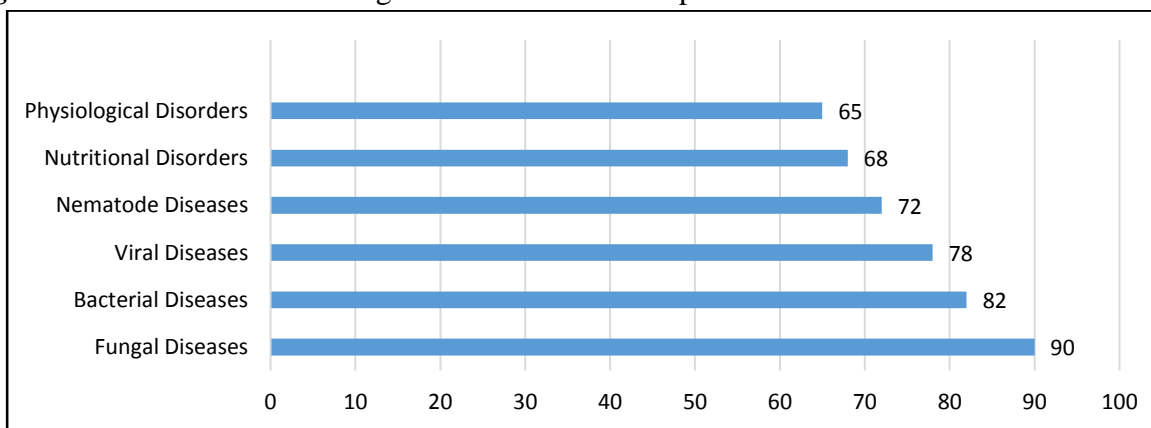


Table 2 shows the effect of different organic fertilizers on crop plant growth. It explains that organic fertilizers improve plant growth by supplying essential nutrients and improving soil conditions. Farmyard manure contains nitrogen, phosphorus, potassium and organic matter, which help improve soil fertility, root development, plant height and overall vegetative growth. Its growth improvement value is 78%, which indicates that it supports healthy crop growth by making the soil more fertile and suitable for root absorption. Compost manure shows 82% growth improvement because it contains organic carbon, micronutrients and humus. It improves soil structure, supports seed germination, increases leaf growth and helps plants absorb nutrients more efficiently. Vermicompost has the highest growth improvement value of 88% because it contains



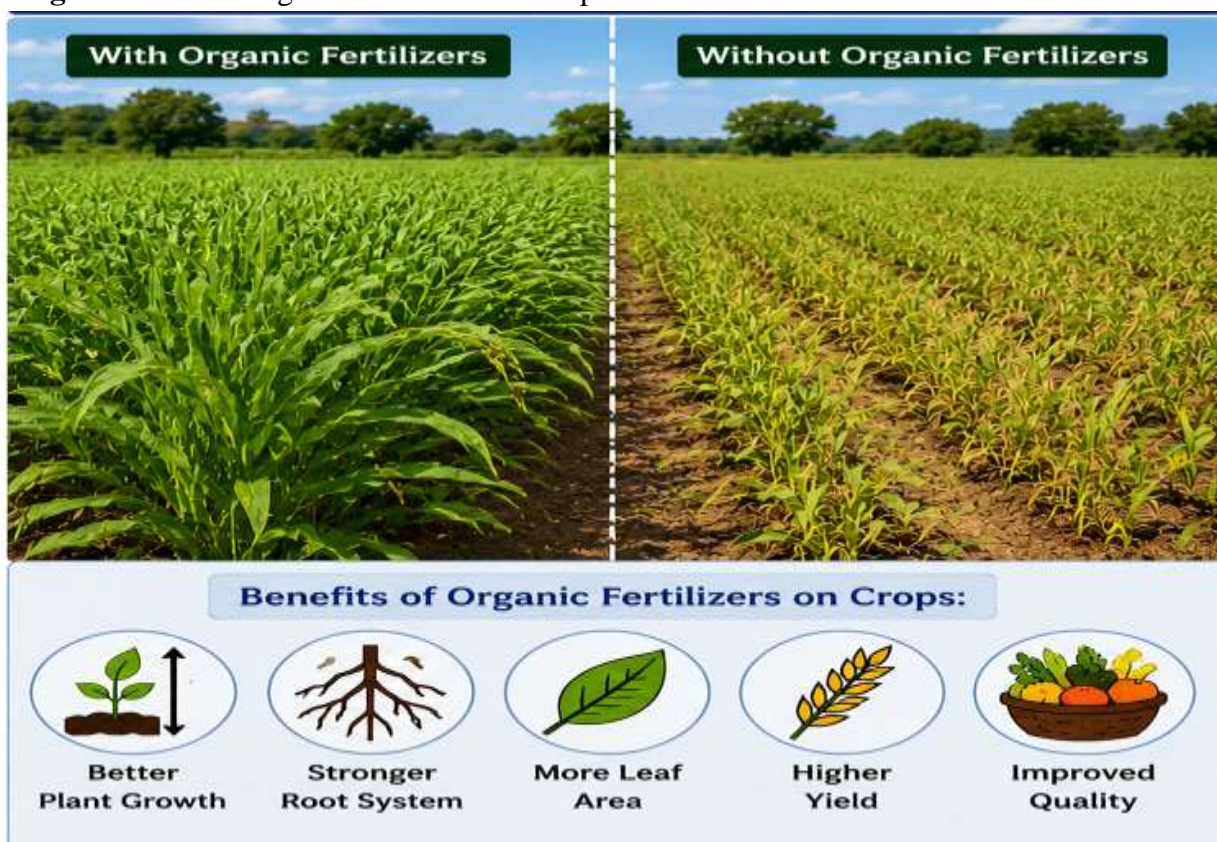
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enzymes, plant nutrients and beneficial microorganisms. It enhances root development, increases chlorophyll content, improves shoot growth and supports biomass production. Therefore, vermicompost is considered one of the most effective organic fertilizers for crop plant growth. Green manure shows 80% improvement as it adds nitrogen and fresh organic matter to the soil. It increases nitrogen availability, improves soil texture and supports healthy plant growth. Biofertilizers also show a high growth improvement value of 85% because they contain beneficial bacteria and fungi. These microorganisms help in nitrogen fixation, phosphorus solubilization and better nutrient uptake by plants. Crop-residue-based manure has a 75% improvement value and helps in moisture retention, microbial activity and gradual nutrient supply. Poultry manure shows 84% growth improvement because it is rich in nitrogen, phosphorus and potassium, which support quick vegetative growth, strong stems and better leaf development. Overall, the table clearly indicates that all organic fertilizers have a positive impact on crop plant growth. Among them, vermicompost, biofertilizers and poultry manure show stronger effects due to their rich nutrient content and ability to improve microbial activity and nutrient availability. Organic fertilizers not only supply nutrients but also improve soil health, which leads to better root growth, leaf development, plant height, chlorophyll formation and overall crop productivity.

**Image 2:** Effect of Organic Fertilizers on Crop Growth and Yield





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Organic fertilizers enhance flowering and reproductive development by providing nutrient balance in the soil. Organic fertilizers provide potassium, phosphorus, calcium and micronutrients and are significant for flower formation, the development of pollen, fruit setting and seed formation. Balanced nutrient supply makes for a successful plant life cycle. Organic fertiliser can also help crops to flower well and have healthier seed and fruit growth. This is because the organic fertilizers not only supply nutrients, but also make the soils more favorable for continuous plant development. Another important effect of organic fertilizers on crop plant growth is stress tolerance. Plants growing in healthy soil are better able to face environmental stresses such as drought, heat, salinity and disease attack. Organic fertilizers increase water holding capacity of soil and this helps the plants to grow during dry spells. They also promote the growth of beneficial microorganisms that also ward off certain soil-borne diseases and boost uptake of nutrients. Organic fertilizers contain potassium and various micronutrients which play a role in making plant tissues stronger, and in making them more resistant to pests and diseases. Overall, the use of organic fertilizers influences the growth of the plant into the crop, by increasing the fertility of the soil, the availability of nutrients, the development of roots, leaves, photosynthetic activity, height of the plant, biomass production and resistance to stress. They can take longer to work than chemical fertilizers, but they have longer lasting and more stable effects. The use of organic fertilizers invariably establishes a healthy soil state and results in vigorous and productive plant crops. Hence, organic fertilizers play significant role to enhance growth of the crops in natural, safe and sustainable way.

## **Role of Organic Fertilizers in Sustainable Agriculture**

Organic fertilizers are highly significant in sustainable agriculture as soil fertility maintenance, crop productivity and environmental protection. Sustainable agriculture is an agricultural system that can maintain the soil, water, biodiversity and natural resources for future generations and produce sufficient food for the current generation. Today, the use of chemical fertilizers has become excessive and while enhancing the production of crops, it has caused some problems in the field of modern agriculture, including soil degradation, imbalance of nutrients, water pollution, decline in soil microbial activity and decreased soil long-term fertility. Organic fertilizers are an environmentally friendly and natural solution to these issues because they help to make soil better and to produce healthy crops. Organic fertilizers like farmyard manure, compost, vermicompost, green manure, biofertilizers and crop-residue based manures increase the organic matter content of soil. Organic matter is the basis of sustainable agriculture as it helps to structure the soil, enhances water holding capacity, supports root development and improves soil aeration. Soils with adequate amounts of organic matter are loose, fertile and more conducive to plant growth. This kind of soil will hold water for a longer period of time and requires less frequent watering. This is particularly significant in water scarce and/or unreliable rain-fed areas. Thus, organic fertilizers naturally help retain water and enhance soil productivity.



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The use of organic fertilizers also promotes sustainable farming practices by releasing nutrients slowly and steadily into the soil. These are rich in nutrients like Nitrogen, Phosphorous, Potassium, Calcium, Magnesium, Sulphur and micronutrients. These nutrients will break down slowly, thus allowing the plants to absorb the nutrients as they require them. This slow release will decrease nutrient losses from leaching and run off. Chemical fertilizers, on the other hand, could be dissolved rapidly and lost if plants are not able to take the nutrients up immediately. Organic fertilizers create conditions which enhance nutrient-use efficiency and help to keep the nutrient balance in soil for a longer time. Favoring soil microbial activity is another important contribution of organic fertilizers in sustainable agriculture. Soil is not only a medium for growing plants, but also a living system that harbors bacteria, fungi, actinomycetes, earthworms and other beneficial organisms. These organisms feed on organic fertilizers to get their food and energy. Microorganisms help in decomposition, nitrogen fixation, phosphorus solubilization, nutrient cycling and humus formation. Humus enhances the fertility of soil in the long-term and makes nutrients available to plants. A more biology active soil is more productive, more resistant to degradation and also more healthy. So organic fertilizers contribute to the natural life of the soil. Organic fertilizers decrease the use of chemical fertilizers and the pollution of the environment. Groundwater, rivers, ponds and lakes could be polluted by excessive and continuous use of chemical fertilizer, via nutrient run off. This can lead to eutrophication, drinking water contamination, etc. Soil nutrient holding capacity is enhanced and nutrients are slowly released by organic fertilizers, reducing such risks. They also contribute to recycling of wastes generated in agriculture, animal wastes, and wastes from kitchen and crops. The farmers can now use the crop residues and organic wastes to make useful manure materials rather than burning them or throwing them away. This minimises waste, eliminates air pollution and contributes to a circular agricultural system.

Organic fertilizers also enhance the quality of the products and food security. Organic fertilisers are frequently of superior taste, better nutritional value and of lower risk of chemical residue in the crop. The goal of sustainable agriculture is to boost production while making safe and healthy food. Organic fertilizers are used in growing crops in a more natural manner that is also good for soil and environmental health. In organic farming systems, using synthetic chemicals is restricted and they are particularly important. Organic fertilizers are also a contribution to climate-friendly agriculture. Soils with high organic matter have the capacity to sequester more carbon, limiting the amount of carbon dioxide in the atmosphere. This is called carbon sequestration. Organic fertilizers improve soil organic carbon, which helps to minimize the effects of climate change. They also enhance crop resistance to drought, heat stress and other stress factors. Good root development, enhanced soil moisture and nutrient availability allow plants to cope with adverse environmental factors. In general, organic fertilizers play a crucial role in the sustainable agriculture due to their benefits of improving the soil health, availability of nutrients, microbial



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activities, pollution control, organic waste recycling, water conservation, crop quality and sustained productivity over time. They can be used regularly to allow the farmers to sustain the crop production without disturbing the natural resources. Organic fertilizers can work slower than chemical fertilizers, but their effects will last longer and won't harm the environment. So, organic fertilizers are a crucial component in eco-friendly farming and sustainable production of crops.

## Conclusion

Organic fertilizers contribute greatly to growth and yield of crop plants through soil improvement and providing natural and balanced nutrients. They increase the organic matter, improve soil structure, increase water holding capacity, enhance soil aeration and promote microbial activity in the soil. These changes will provide a healthy soil environment that roots can grow in and absorb water and nutrients efficiently. Organic fertilizers can be applied to all growth phases of crops from sowing to root development, shoot growth, leaf formation, flowering, fruiting and seed formation. Nitrogen, phosphorus, potassium, calcium, magnesium, sulphur and micronutrients are released over time as the material decomposes and can be taken up by the plants over time. This is a slow release of nutrients, which minimizes nutrient losses and enhances nutrient-use efficiency. Consequently, the organic fertilized crops demonstrate better growth, better biomass, higher quality of yields and more stable productivity. Organic fertilizers also play a role in sustainable agriculture by lessening reliance on chemical fertilizers and minimizing environmental pollution. They facilitate the re-use of farm, animal, kitchen and crop wastes as useful manure. They have long-term beneficial effects on soil fertility and on natural resources (soil, water and biodiversity). Organic fertilizers might take longer to become effective than chemical fertilizers, but they are beneficial and environmentally friendly. Hence, organic fertilizers play an important role in sustainable crop production, soil health and crop yield as well as in creating environment-friendly agricultural development.

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