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Effects of organic manure and fertilizers on physicochemical properties of the soil: A review

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Abstract

In the growing population of the human world, food is the most important need and it leads to an increase in the food production meanwhile the agriculture production land also getting decreasing day by day. So, there is the only way to overcome this situation is to increase the production in the available land which means to increasing the production per unit area, so for that, the application of fertilizers plays an important role in production, it improves the production and yield. Fertilizers are not only improving the yield and production and also have many disadvantages, the artificial fertilizers are having not only the nutrients and also contains many chemical salts that remain left in the soil, those remaining salts are very harmful to the soil because it leads to the decreasing of the soil fertility and causes water pollution, so overusing of the fertilizers and also using the fertilizers for the longer period also leads to the infertility of the soil. For that using of organic manures like FYM, Vermicompost leads to the improving of good soil quality and fertility of the soil. Vermicompost, FYM and Poultry manure are the most used organic fertilizers.

Keywords: Organic fertilizers, Inorganic fertilizers, soil and plants

Introduction

Fertilizers are like enhancing and boosting the growth, development, and yield of a crop. In soil, not all the nutrients are available to the plants, without the availability of proper nutrients to the plants leads to less yield, crop failure, and sometimes leads to pest attacks and disease, to overcome this problem fertilizer application plays an important role in this. Both organic fertilizer and inorganic fertilizer gives proper nutrients to the plants, but inorganic fertilizer gives more nutrients to the plants when compares to the organic fertilizer, inorganic fertilizers contains more vital nutrients which gives more growth and high yield to the plants but overusing of inorganic fertilizers leads to soil organic matter degradation, soil structure destruction and causes land and water pollution, to overcome this problem practicing organic farming is the only solution, Organic fertilizers provide less nutrients to the plants but it makes the plants healthy and it makes the soil more fertile and keeps the soil fertile for a long time and it improves soil physical(soil structure, Soil texture, Bulk density, Particle density, Soil porosity, Soil colour and temperature, chemical(pH, Electrical conductivity, Cation exchange capacity, Available soil organic carbon Total NPK and available NPK, salinity, Sodium Adsorption Ratio and biological (soil microbial activity, available organic matter properties of the soil but in the case of inorganic fertilizers after the plants takes the nutrients the remaining salts stays in the soil and makes the soil infertile and reduces the microbial activity in the soil. So, using more inorganic fertilizer leads to damage to the soil and is more problematic. So combined usage of organic and inorganic fertilizers gives good results and makes less damage to the soil, so practicing combined usage of fertilizers is a good way to overcome this problem.

Organic fertilizers

Organic fertilizers that are made by organic sources that includes compost, poultry waste, animal waste, human waste, plant residues which improves the soil structure, soil texture and improves the soil quality. Some of the examples of organic fertilizers are Vermi-compost, FYM, Rock phosphate, Chicken litter, Bone meal.

Types of organic fertilizers

1. Organic fertilizers based on plants
2. Organic fertilizers based on animals
3. Organic fertilizers based on minerals.

Organic fertilizers based on plants: Compost

Compost is mixture of decomposing plants, cow dung, food waste which improves the quality of the soil and improves the soil fertility and also improves the water holding capacity of the soil and it provides nutrients and promotes growth to the plants.

Sea weed fertilizer

Sea weeds fertilizers which contain high micro and macro nutrients, phytohormones and humid acids which improves the fertility of the soil. In India mainly Tamil Nadu and Kerala Use Sea weed fertilizers for coconut plantations. These fertilizers are derived from the sea weeds which are high in polysaccharides, fatty acids and proteins which helps in improving the nutrient and water retention of the soil and growth of the crop and it also makes plant tolerance to abiotic stressors. Some of the sea weeds used are Sargassum wightii, Gelidella aeros, Ulva lactuca, Pandina pavonia, Dictyota dichotoma (Mohanty *et al.*, 2013) ^[1].

Cotton meal

It is a slow releasing, acidic fertilizer and it is a byproduct of cotton which is extracted from the cotton seeds, which is rich in nitrogen and mostly suitable for garden soils and also used to lower the pH of the soil.

Alfalfa meal

Alfalfa meal is a product of alfalfa plant, which is a booster material for plant growth and it contains important trace elements which helps in flowering and blooming plants and it boosting the flowering stage of the plant. Buurma *et al.*, 1996 ^[3].

Soybean meal

Soy bean meal is a byproduct of soy beans and it is a slow-release fertilizer and a good source of nitrogen and it contains high nutritional value and it is used for vegetable and flower gardens. (Wang *et al.*, 2014) ^[4].

Organic fertilizers based on minerals: Green sand:

Green sand is a slow releasing fertilizer which is rich in potash and which contains high amount of glauconite. It derives from the glauconite mineral and iron potassium silicate mineral it weathers and break downs the minerals they stored. It improves the moisture retention in the soil, soil structure and plant root growth. (Brant *et al.*, 1920) ^[5].

Rock phosphate

Rock phosphate is a slow releasing fertilizer which is a sedimentary rock which is rich in phosphorous and it provides essential plant macro nutrients. Sahu *et al.*, 2000) ^[6].

Organic fertilizers based on animals: Bone meal

Bone meal being a byproduct of slaughter house and it will be a bone of animals and it may be in the powdery form or granular form; it is a good soil enhancer and rich in calcium which makes the plant cell wall stronger. (Jeng *et al.*, 2007) ^[7].

Blood meal

Blood meal is also a byproduct of slaughter house and it is also a slow releasing fertilizer and it is highly acidic and it will be used to lower the pH of the soil and it is rich in nitrogen when compares to the bone meal and also rich in protein. Ciavatta *et al.*, 1997 ^[8,17].

Animal manure

Animal manure consists of feces and urine of animals such as cow, horse, pig, sheep, rabbit, chicken and turkeys which are rich in nitrogen. (Kumar *et al.*, 2005) ^[9].

Fish meal

Fish meal also a slow-release fertilizer and it is a good source of nitrogen, phosphorous, potassium and calcium and it is highly acidic, more usage of this fertilizer leads to burning of plants and it helps to lower the pH of the soil. It improves the fertility of the soil and improves the soil texture. Abedin *et al.*, 2018 ^[10].

Advantages of organic fertilizers

1. It improves the yield and quality of a plant (D Yanar *et al.*, 2011) ^[11].
2. It increases the soil microbial activity and improves the organic matter content in the soil.(L.R. Bulluck *et al.*, 2001)
3. Unlike the inorganic fertilizers it won't runoff easily and it remains in the soil for a long time.
4. Organic fertilizers improves the water holding capacity of the soil (A Vengadaramana *et al.*, 2012) ^[13].
5. Organic fertilizers are not only used as fertilizers and it also works as pesticides (Heeb *et al.*, 2005) ^[14].

Disadvantages of organic fertilizers

1. Organic fertilizers are slowly reacting with the soil and plants when comparing with the inorganic fertilizers (Roba *et al.*, 2018 ^[34].
2. when compares with the inorganic fertilizers, organic fertilizers contain very low nutrients (Jen *et al.*, 2006)
3. Transportation of huge amount of manure to the required site is way difficult.
4. when compared to inorganic manure, organic manures are costly because of its processing and manufacturing cost Alexandra 2013

Inorganic fertilizers

Inorganic fertilizers or synthetic fertilizers that are made artificially packed with nutrients and not by organical way which boosts the plant growth faster, it contains high amount of nutrients when compared to the organic fertilizers and plants reacts more faster to the inorganic fertilizers than the organic fertilizers.

Types of Inorganic fertilizers

1. Nitrogen fertilizers
2. Phosphorous fertilizers
3. Potassium fertilizers
4. Micro nutrient fertilizers

Nitrogen fertilizers

1. Ammonium sulfate (21% N and 11% S)
2. Ammonium phosphates (11–13% N and 48-62% P₂O₅)
3. Potassium nitrates (N (13% and K₂O 44%)

4. Calcium nitrates (15% N)
5. Urea (45–46% N)
6. Sulfur coated urea (36–38% N)

Phosphorous fertilizers

1. Rock phosphate (25-40 P₂ O₅)
2. Single superphosphate (16-22 P₂ O₅)
3. Triple superphosphate (44–53 13 P₂ O₅)
4. Monoammonium phosphate (48-55% P₂ O₅)
5. Diammonium phosphate (46-54% P₂ O₅)

Potassium fertilizers

1. Potassium chloride (60-62% K₂O)
2. Potassium sulfate (50–52% K₂O)
3. Potassium-magnesium sulfate (21-22% K₂O)

Calcium fertilizers

1. Lime (38 Ca)
2. Dolomite (22% Ca)
3. Calcium sulfate (gypsum 23% Ca)

Magnesium fertilizers

1. Magnesium sulfate (Epsom salt (9.8 Mg)
2. Magnesium oxide (55% Mg)

Sulphur fertilizers

1. Elemental sulfur (100% S)
2. Ammonium sulfate (24% S)

Micronutrients

FeSO₄ 7H₂ O (12% S, (19% Fe FeEDTA (5-14% Fe)
 ZnSO₄ H₂ O (18% S (35% Zn ZnEDTA (14% Zn)
 CuSO₄ 5H₂ O (13% S, (25% Cu CuEDTA (13% Cu)
 Borax (11% B)
 Granusol® (5.4% Fe), (5.2% Zn), (5.6% Mn), (5.4% Mg),
 (2.6% Cu), (0.5% B)

Advantages of inorganic fertilizers

1. Reacts with plants very faster when compared to the organic fertilizers (A.R. Rodríguez *et al.*, 2000^[38]).
2. Provides all the nutrients to the plants and readily available (Achieng *et al.*,) 2010.
3. Inorganic fertilizers are very cost effective and cheap when compared to the organic fertilizers (Gupta *et al.*, 2014^[35]).
4. Very easy to use and easy to transport too (ET. Jaja *et al.*,) 2017^[32, 37].

Disadvantages of inorganic fertilizers

1. During leaching all the nutrients provided by the inorganic fertilizers will washed away (Rahman *et al.*,) 2018.
2. Inorganic fertilizers not only contain the nutrients and contains salts after the nutrient uptake by the plants the salts will remains in the soil and makes the soil infertile Gupta, 2014^[35].
3. Not all the inorganic fertilizers are in affordable price some of the fertilizers are way costly Dordas *et al.*, 2014
4. Even they provide so many nutrients to the plants, overusing of the inorganic fertilizers leads to burning of plants and makes the soil infertile, luxurious consumption is nothing but waste in terms of overusing of inorganic fertilizers. Jaja *et al.*, 2017^[32, 37]

Effects of Organic Fertilizers on Soil

Application of organic manures results in increase the plant height number of leaves per plant (F.C.Oad *et al.*, 2004^[18]) It improves the quality of soil physical properties (celic *et al.*, 2004 and biological properties (Marinari *et al.*, 1999). The application of organic manure like vermicompost results in increasing the microbial activity of the soil. (Bibhuti *et al.*, 2011). It improves the growth and yield and also the quality of nitisols. (Getachew *et al.*, 2016) Applications of manure results in increasing soil organic carbon contents and increases saturated hydraulic conductivities and soil aggregates stabilities (Heng Jiang *et al.*, 2018) Penetration resistance reduced in the sandy soil during the application of sludge compost (Tester 1990^[24]). Oil polluted soils which are treated with organic manure like chicken droppings resulting in degradation of crude oil in the soil (Lijah *et al.*, 2003) it improves the activity of nitrogen fixing bacteria and their growth in the soil (Jianqiang *et al.*, 2021)

Effects of inorganic fertilizers on soil

Inorganic fertilizers improve the growth and yield of the plants in high level (Ojeniyi *et al.*, 2002)^[27]. Some inorganic fertilizers help in improving the soil fertility (Cooke GW *et al.*, 1982 but according to the Almiti (2009) inorganic fertilizers decreases the soil organic carbon and degrading the soil structures. Inorganic fertilizers contain salts after the plants takes the nutrients the salts remain in the soil while heavy raining the runoff makes the nutrients wash out and sometimes it pollutes nearby water resources, over using of inorganic fertilizers leads to increasing of soil acidity and it may lead to affects the crop yield (Ojeniyi *et al.*, 2002)^[27] Over usage of inorganic fertilizers leads to the degradation of soil organic matter, increased soil acidity, soil structure degradation which leads to the erosion (Ojeniyi *et al.*, 1981)^[30]

Conclusion

Everyone expects a healthy lifestyle in this modern world, but this can only be achieved by eating healthy foods, so practising organic farming is the only option. However, in this fast- paced world, everyone wants their results immediately, so everyone uses inorganic fertilisers everywhere to maximise yield and speed up results. However, as we have seen, excessive use of inorganic fertilisers causes numerous issues, making it impossible to compare the effects of different inorganic fertilisers. Since it is hard to totally avoid using inorganic fertilisers, we must reduce their use in order to get good results when paired with organic fertilisers. Eventually, there may be a potential for inorganic fertilisers to be completely eliminated from agriculture. Another major issue is that farmers are unaware of the drawbacks of using inorganic fertilisers, therefore we need to educate them about the benefits of utilising organic fertilisers.

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