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**REVIEW ARTICLE**

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# A Novel Eco-Friendly Approach to Study the Effects of Inorganic, Organic and Biofertilizers on some Agricultural Crops

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## ABSTRACT

***Agriculture is the most important enterprise in the world for production of food, feed and fiber, agriculture in modern time is getting more and more dependence on artificial fertilizer and pesticides for maximizing the productivity and economic returns but use of fertilizers and pesticides increasing nitrogen based soil pollution which lowers the soil fertility and a destructive steps towards loss of sustainable agriculture production and productivity. With usage of organic fertilizers which are derived from animals and vegetable organic matters the efficiency of soil fertility for long period of time can be increase with minimum expenditure.***

***The application of organic waste combined with or without mineral fertilizers to soil is considered as good agricultural practices with on one side increases agricultural production and save agro-ecosystem.***

***Bio fertilizers are breakthrough technology that promises very significant impact on farmers in the term of increasing farm productivity and income. The preparation of bio fertilizers can be performed by living cell and efficient strain of microorganisms and Blue Green Algae that helps crop plant to uptake the nutrients by their interactions in the rhizosphere.***

***Keywords: Organic Fertilizers, Bio fertilizers, Microorganisms, Pesticides, Agro Ecosystem and Blue Green Algae.***

## INTRODUCTION

Agriculture is the most important enterprise in the World but I have chosen this topic of research with special context of Indian agricultural crops. Agriculture is the process of producing food, feed, fiber and other desired products by cultivation of plants and the raising of domesticated animals. To make India self sufficient in food grains and to save the millions of people from starvation after independence, green revolution in India initiated by Prof. M.S. Swaminathan since 1960s, which led to a significant increase in the food production.

The measures adopted during the green revolution were use of chemical fertilizers insecticides and pesticides. High yielding varieties (HYV) of seeds and irrigation techniques which simplified the process of agriculture which were widely accepted and adapted by the Indian farmers. The recent development and introduction of biotechnology and genetic engineering (recombine and technology) given a way for ever green revolution.

The population in India is increasing at the rate of 0.03 billion years thus annually increasing the demand for production of more food and fiber to feed a growing population with a smaller rural labor force. Agriculture in modern times is getting more and more dependent upon the steady supply of artificial fertilizers and pesticides there has been much focus only on maximizing the productivity and economic returns but without understanding that the use of fertilizers beyond a limit does not increase the amount of yield. Instead, it increases the amount of nitrogen based pollutants. Low soil fertility is one of the bottle necks to sustain agricultural production and productivity.

Increase crop production largely relies on the type of fertilizers used to supplement essential nutrients for plants. Fertilizers application is required to replace crop land nutrients that have been consumed by previous plant growth with the ultimate goal of maximizing productivity and economic returns.

Nowadays, there is increased emphasis on the impact of soil environment due to continuous use of chemical fertilizers and chemical pesticides have tremendous harmful long-term residual effect not only on the soil-health and crop productivity but also they contaminate the ground water level and ultimately they are incorporated into the food chain in the ecosystem causing human health hazards. At present in our environment lots of pollutants in our environment lots of pollutants are added day by day because of these pollutants, the soil fertility is decreasing the fear of disease in living beings are increasing a lot of poisonous chemicals ad gases prevails in the environment.

## Review of Literature

As already stated the agriculture is the most important enterprise in the world including India (Manimozhi and Gayathri, 2012). Agriculture is a process of cultivation for food, feed and fiber and other desirable useful products for domesticated animals. To make India self sufficient in the food grains to save millions of peoples from starvation, we have adopted green revolution including use of chemical fertilizers, insecticides, pesticides and high yielding varieties of seeds, which simplified the process of agriculture and widely accepted and adopted by the Indian farmers. Increased crop production largely relies on the type of fertilizers used to supplement essential nutrients for plants. Nowadays, there is increased emphasis on the impact of soil environment due to continuous use of chemical fertilizers. It is already reported that chemical fertilizers and chemical pesticides have a large harmful long term residual effects not only on soil health and crop productivity (Khushali et al., 2015) but they also contaminate the ground water level and ultimately they are incorporated into food chain in environment causing human health hazards. At present, in our environment lots of pollutants are added day by day because of these polluting agents the soil fertility is decreasing thus the fear diseases in living beings and low crop productivity are increasing as a lot of poisonous chemicals and gases prevails in the environment (Kaushik et al., 2010). It is there by not only agricultural land and useful soil organisms are affected by these types of chemicals but anthropogenic perturbation (e.g. change in land use and fertilization) has caused a worldwide increase in riverine nutrients (e.g. N and P) (Hang et al., 1999).

During last 50 years agricultural intensification has caused many wild and animal species to go extinct regionally and nationally or worldwide and has profoundly changed the functioning of agro ecosystem. With usage of organic fertilizers which are derived from animals and vegetable matters, the efficiency of soil for lifelong can be increased with minimum expenditure. The application of organic wastes combined with or without minerals fertilizers to soil is considered as a good management practices in any agricultural production system because it improves, plant quality and soil fertility. Biofertilizer is a breakthrough technology that promises very significant impact on the farmers of country in terms of increasing farm productivity and income. Preparation of biofertilizers can be done by living cells or latent cells of efficient strains of microorganism that help crop plant to uptake the nutrients by their interactions in the rhizosphere when applied through seed or soil. They accelerate certain microbial processes in the soil which augment the extent of availability of nutrients in a form easily assimilated by plants. The combined use of organic manure and chemical fertilizers would be promising not only in providing greater stability in production, but also maintain better soil fertility status, and crop quality. A long term research revealed that the application of during manure at 5 t ha-1 y-1 improved soil resources from degradation (Shah et al., 2007). In another study Goyal et al., reported that the yields of pearl millet (*Pennisetum glaucum*), N uptake and N recovery after 4 years of they were greater with the combination of farmyard manure and urea compared with urea alone. The crop used for the study is winter fodder maize (*Zea mays* L) it belongs to poaceae family, order-poales, genus-Zea *robust* fodder maize is grown as an annual forage crop for use as silage for animal feed. In India, it is mainly grown in months of winter.

## Research Objectives

To suggest eco-friendly practices of agriculture for better use of agricultural resources through the integrated management of available soil, water and biological resources combined with limited external inputs. It contributes to environmental conservation and to sustainable agricultural production by maintaining a permanent or semi-permanent organic soil cover. The main objectives of the study are the effects of urea, FYM and azotobacter on the growth parameters of the maize crop. Identify the best combination of fertilizers in optimum quantity, to highlight the advantage of organic and bio fertilizers over chemical fertilizers.

The study aims to aim to improve the quality of the crops through eco-friendly the minimum use of inorganic chemical fertilizers and maximizing the sue of organic and bio fertilizers because inorganic fertilizers display ill effects on environment such as reducing the soil quality and fertility, leaching out and polluting water reservoirs, destroying microorganism and friendly insects, making the crops susceptible of diseases and also reducing the nutritional quality of the crop, thus causing irreparable damage. The study is a comparative analysis of the effects of inorganic, organic and bio fertilizers on the growth and quality of the crop.

## Methodology

### Selection of Seasonal Crops for Study

### Preparation of Pots

The experiment was carried out in known temperature variation and relative humidity during the study period. A total number of 33 pots of equal dimensions were used for the study. 11 different combinations of fertilizers were applied to 11 pots with 2 replicates of each. The internal diameter of pots was 25 cm and the length was 22.5 cm. the pots were placed in 6 rows. The pots were placed 15 cm apart. A homogenous soil weighing 6 kg was added to each pot along with an integration of specific quantities of inorganic, organic and biofertlizers (Pawar et al., 2014).

Urea was applied by the surface application method. Urea granules of 2 to 4 mm size were applied to the surface such that the possibility of its contact with the seeds was minimized urea reacts with water to form ammonium carbonate, which then gets converted to ammonium ion and carbon dioxide. The ammonium ion further reacts with hydroxyl ion to form ammonia and water (Jamilah and Junairti, 2014).

**Equation 1**

$$(NH_2)_2\,CO + 2H_2O \xrightarrow{\text{Soil}} (NH_4)2CO_3$$

Urea Water Urease Ammonium carbonate

**Equation 2**

$$(NH_4)2CO_3 + 2H^+2NH_4^+ \longrightarrow 4NH_4^+ + H_2O + CO_2 \uparrow$$

Ammonium Carbon dioxide

**Equation 3**

$$NH_4^+ + OH^- \rightleftharpoons NH_3 + H_2O$$

Ammonium + Hydroxyl Ammonia

Diammonium Phosphate (DAP) was applied by the banding method. 50 g DAP granules were banded below the seeds. DAP provides the correct proportion of phosphate and nitrogen needed for the plant. It is highly soluble and thus dissolves quickly in soil to release plant available phosphate and ammonium. Alkalie pH develops around the dissolving granule. The ammonium present in DAP is gradually converted to nitrate by soil bacteria resulting in a subsequent drop in pH (Nishat, et al., 2014).

**Seed and Treatment**

The seeds were dipped in the *Azotobactor* liquid for 20 minutes and then allow drying farm yard manure was applied to the soil 15 days prior to the commencement of the experiment. The farm yard manure was thoroughly mixed in the soil with the help of a plough to form a homogenous blend with the soil. Carbon present in soil is in the form of organic matter. For all organic matter atmospheric carbon dioxide serves as the main source of carbon. Also irrespective of source and composition, organic matter when added into the soil undergoes microbial decay and becomes the food for micro flora and fauna (Gupta et al., 2014). Even the microbial cells serve as a source of carbon for succeeding generations of microscopic populations. Carbon is contentiously fixed into organic form through the process of phostosynthesis and once bound the carbon becomes unviable for use in the generation of new plant life. Carbon fixation involves a reduction of carbon dioxide by hydrogen donor NADPH (reduce form of the co-enzyme nicotinamide adenine dinucleotide phosphate, NADP) and the synthesis of carbohydrate from reduce carbon through complex cyclic mechanism called the Calvin cycle.

**Soil Application**

50 ml of *Azotobactor* liqud was diluted with water up to 1 liter and then directly applied to the soil. Four seeds of crops were sown in each of the pots at a depth of two inches. The seeds were placed 20 cm away from each other (Hemalatha and Chellamuthu 2013).

**Plant Analysis**

The numbers of seeds germinated out of the four seeds sown were recorded and the days after which the first cotyledon emerged from the germinated seed were also recorded. Seven days after the sowing of seeds, the number of leaves, leaf area and the plant height were recorded. The tests were repeated every week for four weeks. The area of a leaf is the most common metric for leaf size and defined as the one-sided or projected area of an individual leaf, expressed in $mm^2$.

The plant height was measured from the base of the stem to the tip of the plant in cm the leaf area was measured by tracing the leaf boundary on a graph paper. The boxes covered were then counted to obtain the leaf area in sq cm. plant height, or maximum height ($H_{max}$), is the maximum stature a typical mature individual of a species attains in a given habitat $H_{max}$ is associated with growth from competitive vigor reproductive size, whole plant fecundity and potential life span. At the end of the $4^{th}$ week the plants were care carefully uprooted without damaging the roots, washed dried and immediately transported to the laboratory. The root length and the shoot length were measured in cm. the root shoot ratio was calculated by the following formula:

$$\text{Root shoot ratio} = \frac{\text{Shoot length (cm)}}{\text{Root length (cm)}}$$

The roots were then separated from the soot. The root and shoot mass were separately measured in grams by a micro balanced. The total mass of the plant was obtained by the summation of the root and shoot mass (Bhatt and Dhyai, 2013). Plants from nutrient-poor sites should allocate a greater fraction of new biomass to roots and maintain a higher proportional distribution of biomass in roots than in shoots. Notably, root allocation can be highly plastic across light, nutrient and water supplies. Lower allocation to roots may well be compensated by higher specific root length and by higher uptake rate per allocation to root mass. Length or surface area (Srinivas et al., 2013, More and Patole 2014 and Nikams et al., 2014).

**Total chlorophyll estimation**

1 gm of fresh leaves was crushed in 80 % acetone solution to obtain a homogenous liquid. This liquid was the centrifuge at 2500 RPM for 3 minutes. The supernatant was filtered and its optical density was measured at 652 nm using a spectrophotometer. The total chlorophyll was calculated from the following formula,

$$\text{Total Chlorophyll (mg/g of leaf tissue)} = \frac{27.8 \times OD_{652} \times \text{Volume of acetone (ml)}}{\text{Weight of leaves (g)}}$$

**Leaf pH estimation**

1 gm of fresh leaves was crushed in 20 ml double distilled water. The pH of the liquid was measured using a pH meter. The pH of green leaf tissue, measured by grinding up the tissue and extracting it with distilled water, varies substantially among species. The variation is at least partly intrinsic (presumably genetic) because this pH can differ greatly among different species growing in the same soil. The fresh weight of one healthy leaf was measured in grams by a microbalance. The leaf was than dried in an oven at $38^0$C for 24 hours and the dry weigh was measured. Te water content in the leaf was calculated from the following formula,

$$\text{Water content (\%)} = \frac{\text{Fresh weight – Dry Weight}}{\text{Fresh weight}}$$

**Leaf Area Ratio (LAR)**

Leaf area ration (LAR) is the photosynthetic surface area per unit dry weight of a plant. It is a measure of the efficiency with which a plant deploys its photosynthetic resources. LAR is the one sided area of a fresh leaf, divided by its oven dry mass. LAR tends to scale positively with mass based light saturated photosynthetic rate and with leaf nitrogen (N) concentration ad negatively with leaf longevity and C investment in quantitatively important secondary compounds such as tannins or lignin.

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