

## Organic and Inorganic Fertilizer; Integral Part for Crop Production

Muhammad Adnan<sup>1</sup>, Muhammad Asif<sup>1</sup>, Hafiz Muhammad Bilal<sup>2</sup>, Basat-ur-Rehman<sup>1</sup>, Muhammad Adnan<sup>2</sup>, Taimur Ahmad<sup>2</sup>, Hafiz Abd-ur-Rehman<sup>1</sup> and Muhammad Zohaib Anjum<sup>3\*</sup>

<sup>1</sup>Department of Agronomy, College of Agriculture, University of Sargodha, Pakistan

<sup>2</sup>Department of Horticulture, College of Agriculture, University of Sargodha, Pakistan

<sup>3</sup>Department of Plant Pathology, College of Agriculture, University of Sargodha, Pakistan

\*Corresponding Author: Muhammad Zohaib Anjum, Department of Plant Pathology, College of Agriculture, University of Sargodha, Pakistan.

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### Abstract

Production of enough food to feed the growing population is an important challenge for Pakistan. In modern agriculture fertilizers are important element. It increased the production of food and fiber. In this era, agriculture without fertilizers is not possible. Use of organic and inorganic types of fertilizers helps in the improvement of crop yield.

**Keywords:** Organic Fertilizer; Inorganic Fertilizer; Crop Yield; Plant Growth

### Introduction

A fertile soil is needed to express the actual yield potential of maize. For this enormous and unnecessary use of inorganic fertilizers have deteriorated the land resources, contaminated the environment [1]. The sole use of inorganic fertilizer is hazardous because it is coupled with enhanced soil acidity and nutrient imbalance and long term fertilizer use can pollute the environment [2]. The leaching of nutrients results in the process of eutrophication in aquatic and fresh water bodies [3]. Furthermore, the complete dependence on inorganic fertilizers has increased the cost of production [4]. So as to avoid this alarming situation, integrated nutrient management technique might be used in which natural substances like organic material is used in combination with inorganic materials.

### Organic sources of fertilizers

Application of compost of sewage sludge improves the soil physical and chemical properties [5]. Organic amendments can improve fertility of soil and crop yield [6]. Bio char holds positive cations such as ammonium ( $\text{NH}_4^+$ ), potassium ( $\text{K}^+$ ) and magnesium ( $\text{Mg}^{2+}$ ), preserve these nutrients in the soil for a long time and provide these nutrients to plants in the time of requirement [6]. Farmyard manure provided a long term residual effect on maize when it was applied to wheat in wheat-maize cropping system and it provide more effective results in restoring crop productivity in eroded soils [7-10]. Nitrogen concentration increased in rhizosphere and became more available to plants when bio char is applied to the soil [11]. Application of press mud improved soil characteristics such as amplified organic carbon, total nitrogen and available phosphorus contents in the soil [12]. The impact of press mud was tested on maize growth and yield. The yield increased about 07% - 89% as compare with the control. It also improved nutrient content and soil quality characteristics [13]. Availability of phosphorous to maize through organic manures such as farmyard manure, bio-compost, poultry manure and press mud

was studied under field conditions. Highest phosphorus contents (42.68%) in maize were observed with poultry manure as compared to other sources. In comparison with other treatments, farmyard manure as a source of phosphorus was statistically superior to other treatments showing more availability of phosphorus from soil [14]. Yield for maize grains differ considerably due to the incorporation of organic manures. Grain yield was highest under poultry manure application as compared to other treatments while grain yield for manures was equal or sometimes exceeded when phosphorus was applied from inorganic sources [15]. Organic manures application increased the grain yield of maize as compared to mineral fertilizers [16]. Poultry manure provides more readily available phosphorus than any other organic sources [17]. Dry weight yield of maize is increased through sludge amendment [18]. When compost is added in the soil, nutrients are released and it increases the soil microbial population [19]. Addition of bio char in the soil has many advantages such as improvement in plant growth and soil qualitative characteristics [20] reduce soil carbon dioxide and methane gas emission [21,22]. Bio char application improves soil physical characteristics such as soil strength, soil moisture carrying capacity and soil structure [23] and the soil moisture carrying capacity enhances because of the more surface area of bio char [24]. Soil chemical properties such as cation exchange capacity (CEC) are affected by negatively charged particles present on bio char [25]. Bio char also holds these nutrients tightly and avoid the volatilization and leaching of the nutrients [26]. Organic manure sources improved the availability of organic matter, phosphorus and potassium and the uptake of these nutrients by plants. Similarly, plant height, LAI, dry matter production, and total plant P and K contents were increased by organic amendments. Poultry manure provided comparatively best results regarding P and K contents in plants. It was concluded that improved soil nutrients concentration and plant growth was due to increased nutrient availability in soil from organic manures [27].

Bio char affect plant roots in two ways. Firstly, it is a source of plant nutrition and secondly it affects the nutrients availability to the plants. Immobilization and mineralization are the processes that affect nutrients availability to the plants. Bio char application affects the carbon and nitrogen presence in the soil and it reduces the mineralization process thus making the nutrients available to the plants [28]. Bio char is beneficial for soil microorganism population, enzyme arrangement and for different soil minerals. Due to biogeochemical properties of bio char on crop growth, it increases the microbial activity within the soil profile [29]. Higher doses of bio char results in increased fungal and bacterial growth [30].

### Inorganic sources of fertilizers

Dry matter production in maize increased significantly at each level of nitrogen addition when nitrogen added increased from 40 to 240 kg/ha [31]. Increasing nitrogen rates increase maize grain yield and nitrogen contents of maize grain [32]. Increasing nitrogen and phosphorus rates affected the plant height, stem diameter, LAI and dry matter yield significantly. Highest green biomass was achieved with increasing fertilizer levels [33]. Higher N application resulted in better growth and development; tasseling, silking and 1000-grain weight was also influenced significantly [34]. Increasing levels of nitrogen produced significantly increased grain yield. Nitrogen application is necessary to increase maize grain yields, physical grain quality [35,36] enhance kernel density [37].

### Combination of organic and inorganic sources of fertilizers

Integrated application of nutrients from farmyard manure and NPK fertilizer sustained soil fertility and crop yield [38]. A seven-year continuous field experiment on pearl millet-wheat cropping sequence was conducted by [39] and found that soil organic carbon, N, P and K status in soil increased for all treatments as compared to chemical fertilizer application. Soil microbial biomass also increased due to organic matter addition and combined use of organic and inorganic fertilizer compared with application of chemical fertilizer alone. So, it can be interpreted that organic and inorganic fertilizer, applied in combined use, is essential in sustaining the soil organic matter contents and soil fertility status especially in tropical soils where organic matter is very low. Incorporated usage of organic and inorganic nutrients source had a greater beneficial effect on soil microbial population and soil health as compared to organic fertilizers application [40]. Balanced nutrients from both sources should be used to obtain sustained crop production [41]. This is due to the fact that soils are deteriorated due to recycling of organic wastes and longtime use of inorganic fertilizers. Integrated nutrient management with balanced

nutrient provision is necessary to enhance crop productivity [42]. Crop yield increased significantly due to integrated use of organic and inorganic fertilizers [9,10,42].

Checked the effect of press mud in an experiment on growth and yield components of maize and wheat. Wheat grain yield and maize cob yield were highest when press mud was applied. The soil physical and chemical properties were improved when press mud was applied combined with chemical fertilizers [43]. Combined application proved to be helpful in improving and maintaining soil fertility [44]. Application of poultry manure at rate of 10 t per ha with NPK recommended dose (150+75+ 37.5 kg per ha) produced maximum grain yield (50.8 q/ha) than farm yard manure vermicomposting combined with fertilizer's recommended dose. Maximum plant height (187.5 cm), heavier cob weight (170.5 g/cob) and longer cobs (14.35 cm) were obtained using poultry manure with recommended dose of fertilizer than with control [45].

Organic matter acts as source and sink of plant nutrients in the soil as organic matter has nutrient holding capacity. It stores the plant nutrients like nitrogen, sulfur, phosphorus etc. and has the ability to supply these nutrients to plants in time of need for better plant growth and development. It improves the soil physiological properties such as soil structure, soil aeration, soil water holding capacity, soil aggregation along with reduction of soil bulk density and soil erosion [46]. Soil properties and maize yield as influenced by integrated nutrient management was studied by [47] suggested that chemical properties of soil have been changed after organic fertilizer application but maximum grain yield (6.65 t/ha) was recorded when sole chemical fertilizer was applied followed by the (5.66 t/ha) grain yield with compost. Madejon E., *et al.* [48] reported the higher crop yield was observed when amended organic matter with inorganic fertilizer as compared to sole inorganic fertilizer and control. Application of sole Nitrogen fertilizer minimized the organic matter of soil and also the Nitrogen contents but these were enhanced with combined application of N fertilizer and organic matter [49]. Soil micronutrients such as Fe, Cu and Mn increased when soil is added with 100%+ FYM. In another experiment same results were observed by [50] that combined application of poultry manure and press mud with NPK provided higher residual effect on chemical composition of soil and also increased plant height, leaf area, dry matter, grain yield as well as improved nutrient uptake in maize [51].

Organic fertilizer provided highest grain yield (67.47 q/ha) as compared with other treatments [52]. Compost along with chemical N fertilizer provided a significant higher grain yield and dry matter than alone chemical fertilizer application [53]. Bio compost increased soil electrical conductivity, soil organic matter, Olsen-P and  $\text{NH}_4\text{OA}_c\text{-K}$  while chemical fertilizer increased Olsen-P and  $\text{NH}_4\text{OA}_c\text{-K}$  contents in the soil. The findings expressed that combination of bio compost and inorganic fertilizer can increase maize growth and yield [54]. Bio char increased oil contents of maize by 12% and 29% over no bio char and control respectively. Bio char also increased protein content of maize grain. FYM also increased grain protein contents by 12% over control. N application increased protein and oil content in maize. Overall bio char is recommended to be applied as it provided better results over sole application of FYM and mineral N [55].

Grain yield and other yield attributes were increased significantly with the application of mineral fertilizer along with poultry manure and cow dung [56]. Plant growth parameters like plant height, stem girth, no. of green leaves, maize fodder yield significantly increased with the combined application of nitrogen fertilizer and farmyard manure [57].

## Conclusion

Maximum grain yield ( $4402 \text{ kg ha}^{-1}$ ) was recorded under the application of vermicompost @  $5 \text{ t ha}^{-1}$  combined with 75% NPK recommended dose and it was highest when compared with other treatments. Highest calcium contents in soil (0.139%), magnesium contents in soil (0.281%), protein contents in maize (16.67%) and starch contents in maize (81.34%) were also recorded under the application of vermicompost @  $5 \text{ t ha}^{-1}$  + 75 NPK recommended dose. So, it was concluded that maize crop produced significant results regarding growth and yield parameters and soil fertility status was also improved by the combine use of vermicompost stand inorganic fertilizers [43].

Application of poultry manure @  $15 \text{ t ha}^{-1}$  combined with inorganic nitrogen fertilizer @ 120 kg per ha expressively increased grain weight/cob, leaf area index, plant height, 100 grain weight and number of grains/cob [58]. Maximum dry matter yield and total grain yield

was obtained under the combined application of poultry manure @ 10t/ha and Nitrogen fertilizer at 80 kg per ha. Application of farm yard manure @ 3000 kg ha<sup>-1</sup>+ 100 kg N<sub>15</sub> P<sub>15</sub> K<sub>15</sub>+ 50 kg urea ha<sup>-1</sup> produced 40% greater grain yield over control and this treatment was proved to be superior over all other treatments. All combined application treatments significantly increased the yield as compared to control [59].

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