Fertilizer Effects on Fertility in Various Betul District Areas

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Abstract- This study looked at the effects of five fertilization treatments on soil parameters in the ploughed layer (0-20 cm) of paddy soil in Betul District, Madhya Pradesh, from 2016 to 2022. These parameters included pH, SOC, TN, C/N ratio, and accessible nutrients (AN, AP, and AK). There were a number of different treatments, including no fertilizer (CK), straw return (SR), chemical fertilizer (NPK), organic manure (OM), and green manure (GM). While OM treatment resulted in the highest average AN and AP levels, NPK therapy resulted in the second highest (1.2 and 20.3 times higher than CK, respectively) during the course of the trial. Soil fertility may be increased here by applying organic manure and K fertilizer while taking the existing K content into account. Our findings imply that yearly straw replanting might increase soil fertility in this section of the Betul district.

Keywords: CK, SR, NPK, OM, GM, FERTILIZER

INTRODUCTION

The effect of chemicals on the richness of the land in the different places that make up the Betul district in Madhya Pradesh is an important thing to think about if you want to farm in a way that is good for the environment. The usage of fertilizers may help with a number of essential objectives, including increasing agricultural output and resolving nutrient imbalances in the soil. However, since the district uses a broad range of soil types, cropping patterns, and agricultural techniques, the precise impacts of fertilizers may differ from one section of the district to another.

There are several different types of soil in the Betul region, including alluvial plains, black soil, red soil, and sandy soil. Each of these soil types has a unique set of traits that make it fertile. These alterations in the soil directly affect the soil's ability to store nutrients, as well as its capacity to hold water and its overall fertility. [1] Because of this, fertilizer efficacy might differ from location to region, necessitating the employment of customized nutrient management systems.

Furthermore, there may be variations within the district itself in terms of the accessibility of irrigation infrastructure, the availability of high-quality fertilizers, and the level of farmer understanding of the most effective fertilizer application techniques. The district consists of a number of smaller districts, which explains this. These elements have the power to impact fertilizer consumption as well as the efficiency of such applications in increasing crop production and enhancing soil fertility. [2]

It is necessary to use a comprehensive approach to investigate the impact that fertilizers have on regional fertility within the Betul area because of the intricate interactions that exist between the various types of soil, cropping patterns, agricultural practices, and local socio-economic aspects.[3] This is due to the fact that only by using such an approach will it be feasible to ascertain the effect that fertilizers have on regional fertility. It will be necessary to conduct comprehensive soil testing, field trials, and monitoring programs in order to achieve this goal.

The most significant factors that affect soil type are included in the list below:

Regional Diversity and Rural Landscape

The Betul district of Madhya Pradesh depends on regional heterogeneity for its agricultural practices and soil fertility. Black, red, and sandy soils, as well as alluvial plains, have an effect on the region's soil fertility and nutrient retention. Agriculture in the area is influenced by terrain, climate, and farming customs. Different farmers have changed how they conduct their agriculture. Market demand, agro-climatic appropriateness, and cultural factors all affect crop choice. While wheat, rice, and pulses are grown in

certain areas, cotton and soybeans are grown in others. Horticulture and floriculture are practiced in the region. The region's economy is influenced by agriculture. It enhances rural life and creates jobs. For Betul to implement targeted interventions, boost productivity, and promote sustainable agriculture, it is essential to comprehend regional variance and agriculture.[4]

Fertilizers' Contribution to Increasing Soil Fertility

Fertilizers are necessary for eco-friendly farming and soil fertility. Agricultural production and ecological balance are maximized by rich soil. The ability of the soil to support plants is known as fertility. Fertilizers boost plant growth and soil nourishment. There are several advantages of fertilizers for soil fertility. A fertilizer feeds the soil. N, P, and K, three macronutrients, support plant growth and development. Fertilizers provide the readily available macronutrients that soils lack.

For the metabolism of plants, fertilizers provide soil nutrients. Plant growth enhances output and product quality. Fertilizers raise the pH of the soil. Plant nutrition is impacted by soil pH. Some crops like acidic soil while others prefer alkaline or neutral soil. [5] For crop growth, fertilizers modify the pH of the soil. Lime fertilizer helps acidic soils into plant-friendly.

Overuse of fertilizers may harm the ecology and fertility of the soil. Water becomes contaminated and eutrophic due to overnutrition. Fertility is decreased when soil is salinized or acidified. Soil testing and nutrient management strategies are necessary for fertilizer optimization and environmental protection.

Localized Factors Affecting Fertilizer Impact

Depending on local variables, fertilizers might impact the soil fertility in Betul, Madhya Pradesh. These variables affect the efficacy and efficiency of fertilizers, assuring crop nutrient availability and absorption. Fertilizer is affected by soil type. Sandal soil, black soil, red soil, and alluvial plains all hold different types of organic matter and nutrients. Soil knowledge is necessary for nutrient addition.

In different areas, fertilizers also have an impact on agricultural practices and crop patterns. Crop rotations, nutritional requirements, and crop choices vary by region. While some areas focus on food or horticulture, others specialize on cash crops. By taking these factors into account while applying fertilizer, farmers may maximize nutrient use and meet the nutritional requirements of their crops.

Water availability, irrigation techniques, and farmer expertise all affect how well fertilizers work. To reduce nitrogen runoff and increase plant absorption, areas with few water resources may need more strategic fertilizer delivery techniques, such as drip irrigation or fertigation.

Issues and Dangers Related to the Use of Fertilizer

Fertilizer use in agriculture may be beneficial or detrimental. Nutritional imbalances, soil acidification, and groundwater contamination may result from excessive usage or poor application. This is important. Overuse of fertilizers may harm the ecosystem and the air. Production of greenhouse gases is one. Finding economical, high-quality fertilizers may be challenging for farmers, particularly those who live in remote areas. An appropriate education, careful nutrient management, and sustainable fertilizer use are required to prevent risks, ensure long-term soil fertility, and maintain environmental sustainability. These substances are used to get this.

Regionally Specific Approaches

The many regions that make up the Betul district of Madhya Pradesh need regionally specific approaches to controlling soil fertility and applying fertilizers. Successful nutrient management calls for systems that are specifically created since every region has varied soil characteristics, cropping patterns, and agricultural practices.

To comprehend the nutritional imbalances and shortages that occur in each region's soil, comprehensive soil testing and analysis are performed in regionally specific approaches. Based on this information, tailored fertilizer formulations and application rates may be created to meet the particular nutritional requirements of the crops grown there.

By using such techniques, farmers may reduce nutrient losses, fertilizer use, and environmental pollution. Regionally specific protocols ensure that the right fertilizers are applied when and where they are needed, increasing crop output, lowering production costs, and ensuring the sustainability of agriculture. [6] Regional fertilizer usage and soil fertility management help Betul district farmers make educated choices,

maximize nutrient availability, and achieve sustainable agricultural practises.

METHODOLOGY

Materials and Methods

Experimental Site

The Madhya Pradesh state of India is where the Betul district is located. The Betul district has a variety of geographical features, including plains, hills, and plateaus. The Satpura Range, within which the district is situated, contributes to its diversified geography. The Betul region has scorching summers and mild winters due to its subtropical climate. The majority of the land in the region is used for agriculture, using a combination of rainfed and irrigated farming techniques. One of the most important crops grown in the region is wheat, along with soybeans, pulses, oilseeds, and maize.

Laboratory Design

Five distinct approaches were used: Organic manure (OM), green manure (GM), chemical fertilizer (NPK) and straw that had been brought back from the field (SR). Three replications of each treatment were employed over 15 plots in a randomized block design. The adjacent farms' fertilization methods were taken into account while selecting these fertilization methods.

Urea, potassium chloride and calcium-magnesium phosphate, were each administered at dosages of 223-132-223 kg.hm-2 during NPK therapy. Before seeding, 60% of the N, P, and K fertilizer was smeared as base fertilizers, while the remaining 40% was used as top-dressing fertilizer. Fresh pig manure weighed 4080 kg in total and underwent OM treatment. All of the pig excrement utilized in the experimentation approached from a pig ranch, where it was fermented for a few months and then heated to compost, producing excellent organic fertilizer. Fresh milk vetch was given the GM treatment at a fresh weight application rate of 22500 kg/hm, which is equal to the rate at which green manure is typically applied in the area.

Analysis of a soil sample

We took soil samples from 15 different locations. Five randomly chosen places were sampled using a 5 cm auger in the plough layer (0–20 cm) of each plot, and the results were aggregated from all five locations. After being air dried, sieved, and preserved for nutrient analysis, all freshly obtained soil samples were examined. The chemical and physical features of the soil were assessed after soil samples were gathered. Utilizing a glass electrode and a 1:2,5 soil/water solution, the pH of the soil was determined. K_2CrO_7-H_2SO_4 oxidation was used to determine SOC, whilst the Kjeldahl technique was used to evaluate TN. The SOC to TN ratio was used to compute the soil C/N levels. Alkaline hydrolysis followed by micro-diffusion identified AN. Olsen computed the AP. After NH_4OAc neutral extraction, AK was measured by flame photometry.

Data Analysis

The results were presented as the mean SE based on three independent measurements. Longitudinal soil nutrient concentrations for various fertilizer treatments were compared using one-way ANOVA and Duncan's multiple comparisons. The yearly results under various treatments were then used to study the nutritional dynamics over time. All statistical analysis was conducted in SPSS.

RESULTS

Effects of Various Fertilizer Applications on Soil C/N Ratio

The soil C/N ratio varied significantly across treatments as a result of fertilizer application (Figure 1). In comparison to the other treatments, the average C/N ratio for the OM therapy was 10.98, which was substantially higher (P 0.05). Similar to how much greater than CK the C/N ratio employed in the SR therapy was. The C/N ratios in the SR, CK, NPK and GM, treatments ranged from 9.66 to 10.00 and showed no appreciable changes.

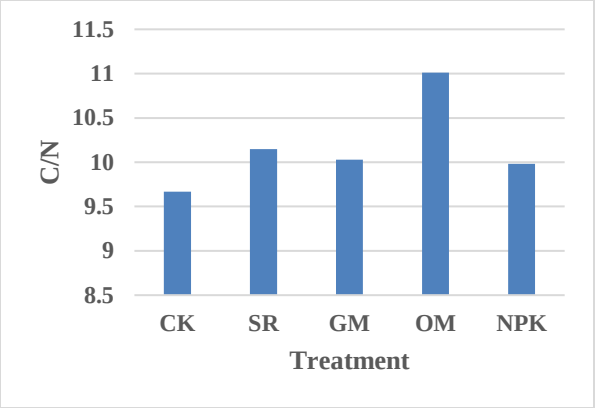

Fig 1.

Figure 6 depicts the fluctuating C/N ratios in soils from 2016 to 2022. C/N ratios for both OM and GM treatments skyrocketed between 2016 and 2018 by an astounding 20.0% and 12.9%, respectively. After peaking in 2010 with 11.98 and 10.14, respectively, both numbers declined consistently until 2020. From 2016 to 2020, administration of various therapies, including CK, SR, and NPK, remained at a steady level (about 8.0). All five treatments followed the same general trends throughout the last two years of the trial, with small variations between 8.28 and 11.68.

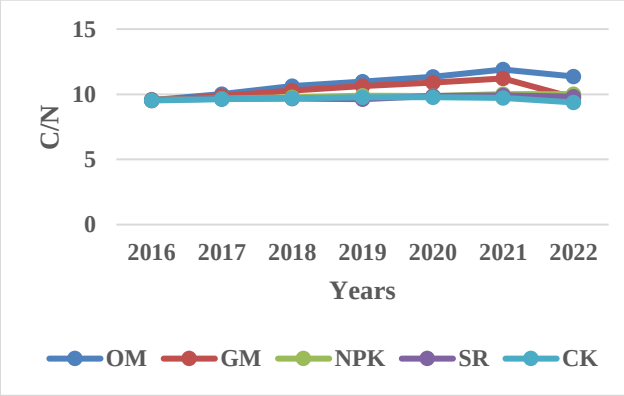

Fig 2.

Effects of Various Fertilizer Applications on the Soil's Absorbable Nutrients

Fertilizer significantly affected soil AN, AP, and AK, as shown by a comparison of the nutrients that were present after the treatments (P0.05, Fig. 3A-C). While NPK therapy came in second (1.2 and 20.3 times CK), the average AN & AP concentrations in OM were at their maximum levels during the experiment (1.6 and 29.6 times CK, correspondingly). In contrast to AN and AP, the NPK treatment had the greatest value of AK content, which was 38.10 mg.kg-1 (approximately 2.2 times that of the CK), and the other four treatments did not significantly vary from one another (Fig. 3C).

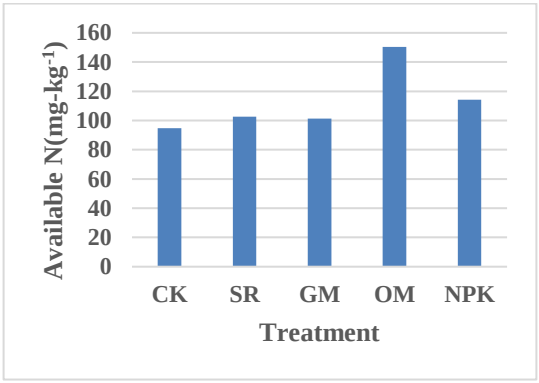

Fig 3(a).

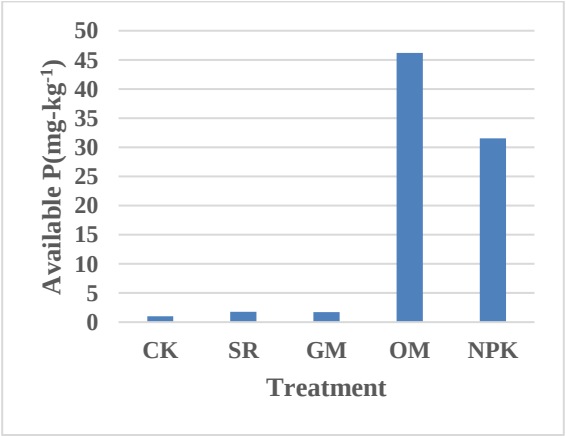

Fig 3(b).

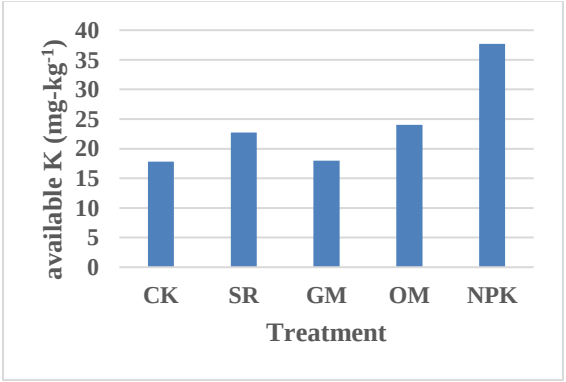

Fig 3(c)

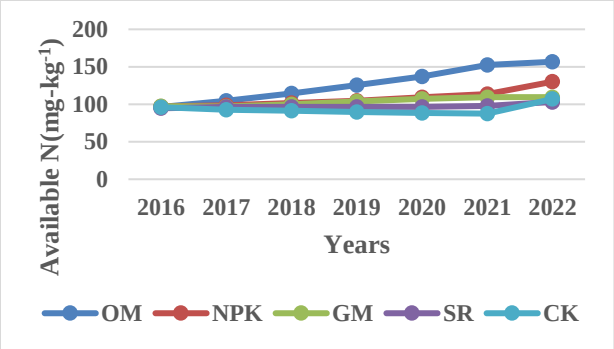

Fig 4(a).

Due to fertilization, AN in the OM therapy first increased, then varied until reaching the highest amount of the other treatments. SR, GM, and CK did not significantly vary from NPK, which had a similar trend but was lower than OM (Fig. 4A).

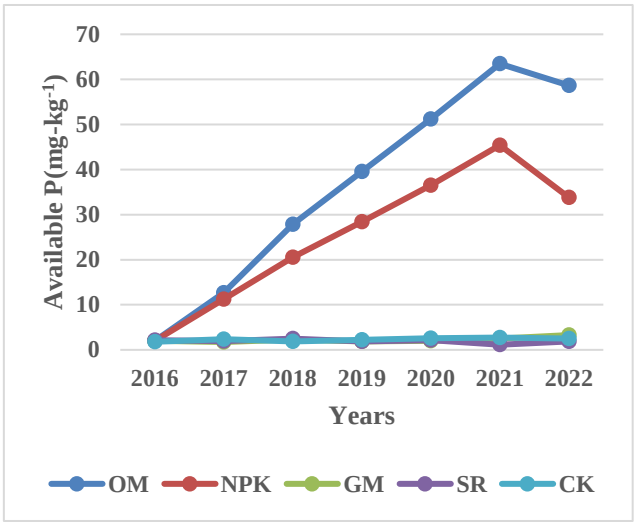

Fig 4(b).

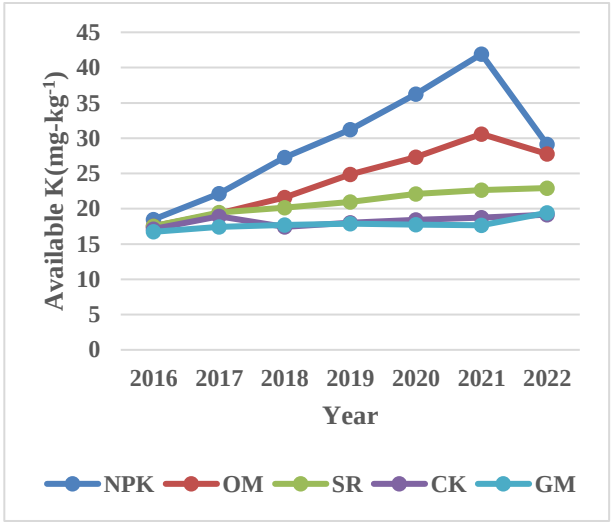

Fig 4(c).

Throughout the course of the experiment, AP concentrations in the CK, SR, and GM treatments were really low (1.80 mg.kg^{-1}) as well as closely resembled the initial values. In both OM and NPK treatments, AP changed equally. In the early years of fertilization, the value rose sharply (63.59 and 45.54 mg.kg^{-1} in 2021), then fell until 2022 (25.37 and 16.68 mg.kg^{-1}, correspondingly), before gradually rising again (Fig. 4B).

From 2018 to 2022, NPK boosted AK content considerably. AK in other treatments remained steady and low throughout time. (Fig.4C).

CONCLUSION

In conclusion, soil fertility in the Betul district region soil area was dramatically impacted by fertilization treatments. OM and NPK raised C/N,TN, SOC ratios, AN, and AP in comparison to different fertilization treatments. Soil fertility may be increased by OM and NPK. The highest levels of AK in soil are increased by NPK. C/N ratios, TN, SOC, and were all kept constant by continuous SR. GM has a negligible effect on soil fertility when compared to CK. In order to increase soil fertility in this area, organic manure and K fertilizer must be smeared taking into account the soil K content. This trail stretch could benefit an annual straw returning application for long-term fertilizer effectiveness.

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