Impact of Fertilizers on the Fertility of Different Regions Betul District, Madhya Pradesh

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Abstract- This research looked at the ploughed layer (0-20 cm) of paddy soil in Betul District, Madhya Pradesh, from 2016 to 2022, and analyzed the impacts of five fertilizer treatments on soil pH, SOC, TN, C/N ratio, and accessible nutrients (AN, AP, and AK). These included control (CK), straw return (SR), chemical fertilizer (NPK), organic manure (OM), and green manure (GM). Over the study period, the average AN and AP levels were greatest in OM treatment (1.6 and 29.6 times higher than CK, respectively), followed by NPK therapy (1.2 and 20.3% higher). NPK treatments had the greatest AK content at 38.10 mg.kg^{-1}. Thus, considering soil K concentration, organic manure and K fertilizer should be administered to boost soil fertility in this location. Our findings imply that yearly straw returning treatment might boost soil fertility in this Betul district location.

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

INTRODUCTION

The influence that fertilizers have on the fertility of the land in the various areas that make up the Betul district in Madhya Pradesh is an essential factor that must be taken into consideration for agricultural practices that are environmentally responsible. Enhancing crop yield and correcting nutrient imbalances in the soil are both important goals that may be accomplished with the use of fertilizers. However, the exact effects of fertilizers might range from one area of the district to another owing to the extensive variability of soil kinds, cropping patterns, and agricultural practices that are used in the various portions of the district.

Alluvial plains, black soil, red soil, and sandy soil are some of the several kinds of soil that can be found in the Betul area. Each of these soil types has its own set of distinct fertility characteristics. These changes in the soil have a direct influence on the capacity of the soil to store nutrients, as well as its ability to retain water and its general fertility.[1] Because of this, the effectiveness of fertilizers may vary from area to region, which calls for individualized strategies for the control of nutrients.

In addition, the availability of irrigation infrastructure, access to high-quality fertilizers, and the degree of awareness among farmers on the best ways for applying fertilizer could differ from one area of the district to another within the district itself. This is because the district is made up of several smaller districts. These factors have the ability to influence the use of fertilizers as well as the effectiveness of such applications in boosting crop yield and improving the fertility of the soil.[2]

Due to the complex interaction that exists between the various types of soil, cropping patterns, agricultural practices, and local socio-economic aspects, it is necessary to use a comprehensive approach in order to examine the influence that fertilizers have on regional fertility within the Betul area.[3] This is because it is only through the application of such an approach that it will be possible to determine the impact that fertilizers have on regional fertility. In order to accomplish this objective, extensive soil testing, field experiments, and monitoring programmes will need to be carried out.

The most significant factors that have an impact on soil type are included in the list below:

Rural Landscape and Regional Diversity

Soil fertility and agricultural practises in Madhya Pradesh's Betul district depend on regional variability. Alluvial plains, black, red, and sandy soils impact soil fertility and nutrient retention in the area. The district's agricultural environment depends on geography, climate, and farming traditions. Different farmers have altered their agricultural practises. Crop selection is influenced by market demand, agro-climatic suitability, and culture. Some regions cultivate cotton and soybeans, while others grow wheat, rice, and pulses. The area contains horticulture and floriculture.

Agriculture impacts the area's economy. It produces employment and improves rural life. Understanding regional variation and agriculture is crucial for Betul's targeted interventions, productivity increases, and sustainable agriculture.[4]

Role of Fertilizers in Increasing Soil Fertility

Soil fertility and eco-friendly farming need fertilizers. Rich soil maximizes agricultural productivity and ecological equilibrium. Fertility is the soil's capacity to nourish plants. Fertilizers improve soil nutrition and plant growth. Fertilizers have several soil fertility benefits. Fertilizers nourish soil. Macronutrients—N, P, and K—help plants grow and develop. Fertilizers supply soil shortages with easy-to-use macronutrients. Fertilizers offer soil nutrients for plant metabolism. Plant growth improves production and quality. Fertilizers increase soil pH. Soil pH affects plant nutrition. Some crops like acidic soil, others alkaline or neutral.[5] Fertilizers adjust soil pH for crop development. Acidic soils become plant-friendly using lime fertilizer.

Fertilizer overuse may impair soil fertility and the ecology. Overapplied nutrients contaminate and eutrophy water. Salinizing or acidifying soil reduces fertility. Fertilizer optimization and environmental protection need soil testing and nutrient management strategy.

Localized Factors Affecting the Impact of Fertilizer

Fertilizers affect soil fertility in Betul, Madhya Pradesh, depending on regional factors. These factors impact fertilizer effectiveness and efficiency, ensuring crop nutrient availability and absorption. Soil type affects fertilizer. Alluvial plains, black soil, red soil, and sandy soil retain various organic matter and nutrients. Nutrient addition needs soil understanding.

Fertilizers also affect cropping patterns and agricultural practises in various districts. Regional crop selection, nutritional needs, and crop rotations differ. Some regions specialize on cash crops, while others on food or horticulture. Farmers may optimize nutrient utilization and satisfy crop nutrient needs by considering these aspects while applying fertilizer.

Fertilizer efficacy depends on water availability, irrigation practises, and farmer knowledge. Regions with limited water resources may need more strategic fertilizer delivery methods like drip irrigation or fertigation to minimize nitrogen runoff and maximize plant absorption.

Problems and Risks Associated with the Use of Fertilizer

Fertilizer usage in agriculture may be good or bad. Overuse or improper application may cause nutritional imbalances, soil acidification, and groundwater pollution. This is crucial. Fertilizer overuse may cause air and environmental damage. Greenhouse gas production is one. Farmers, especially those in distant places, may have trouble finding affordable, high-quality fertilizers. To avoid hazards and assure long-term soil fertility and environmental sustainability, proper education, precise nutrient management, and sustainable fertilizer usage are needed. Combining these ingredients does this.

Need for Regionally Specific Approaches

The different areas that make up Madhya Pradesh's Betul district need regionally specialized techniques to managing soil fertility and using fertilizers. Since each location has different soil properties, cropping patterns, and agricultural practises, successful nutrient management requires specially designed approaches.

Comprehensive soil testing and analysis are used in regionally tailored techniques to understand the nutrient imbalances and deficiencies that exist in each region's soil. This data forms the basis for developing specialized fertilizer formulations and application rates that cater to the unique nutritional needs of crops cultivated in that region.

Farmers may reduce nutrient losses, fertilizer consumption, and environmental contamination by using such methods. Regionally tailored procedures guarantee that the proper fertilizers are administered where and when they are required, improving crop yield, production costs, and agricultural sustainability.[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 Betul district is situated in the country of India's Madhya Pradesh. The geographical characteristics of the Betul district, which include plains, hills, and plateaus, are varied. The district is located inside the Satpura Range, which adds to its varied topography. The Betul district has a subtropical climate, with hot summers and moderate winters. The land usage in the area is largely agricultural, with a mix of rainfed and irrigated farming practises. Wheat, soybeans, pulses, oilseeds, and maize are among the principal crops farmed in the area.

Experimental Design:

Organic manure (OM), synthetic NPK fertilizer (NPK), Straw from the field (SR), and green manure (GM) were the five treatments employed. There were 15 plots in a randomized block design, and every treatment was simulated three times. The selection of these fertilizing methods was based on the input of regional farmers.

The NPK treatments included the application of 223 kg.hm-2 of urea, 223 kg.hm-2 of calcium-magnesium phosphate, and 223 kg.hm^{-2} of KCI (potassium chloride). N, P, and K fertilizer were smeared as base fertilizers (60%) and top-dressing (40%), respectively, before planting. 4080kg.hm of fresh pig dung were treated with OM. All of the pig manure utilized in the study came from a pig farm, where it had been composted at high temperatures to create a high-quality organic fertilizer. Traditional green manure application rates in the area were used to determine how much fresh milk vetch to use in the GM treatment.

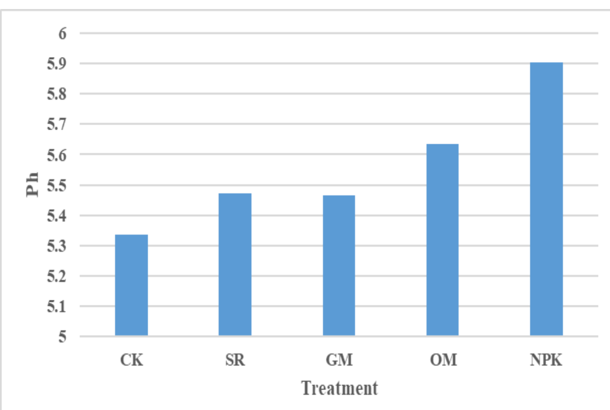

Fig 1.

Applications of different fertilizers on the total nitrogen and organic carbon content of the soil

From below, Fig. 3 shows the statistically significant differences in SOC and TN content among the five treatments. When compared to CK, SOC and TN

Analysis of Soil Sampling:

Fifteen locations had soil samples obtained from them. Five locations within a given plot were sampled at random using a 5 cm auger in the plough layer (0-20 cm), and the results were combined. The nutrients in the fresh soil samples were analyzed by air drying, sieving, and storing them.

After collecting soil samples, scientists analyzed them to determine the soil's physical and chemical properties. The soil's pH was measured using a glass electrode and a suspension (1:2.5) of soil and water. K2CrO7-H2SO4 oxidation was used to detect SOC, while the Kjeldahl technique was used to measure TN. The ratio of SOC to TN was used to obtain the soil C/N values. Micro-diffusion following alkaline hydrolysis determined AN. Olsen calculated AP. Flame photometry measured AK after NH4OAc neutral extraction.

Data Analysis:

Every result was presented as the mean with ± standard errors (SE) based on three replications. Longitudinal soil nutrient concentrations were compared between fertilizer treatments using one-way ANOVA and Duncan's multiple comparisons. Next, we used the annual data across treatments to analyze the nutritional dynamics over time. All statistical analyses were done in SPSS.

Results

Effects of Various Fertilizer Applications on Soil pH:

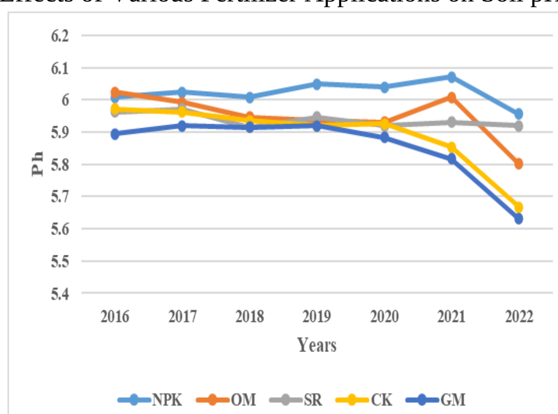

Fig 2.

levels were enhanced by fertilizers, particularly NPK and OM fertilizers. The TN and SOC concentrations generated by OM were 72.5% and 51.2% greater than those produced by CK, at 16.93 and 1.54 g.kg^{-1} correspondingly. SOC as well as TN in NPK treatment existed greater than CK by 11.97 and 1.20 g.kg^{-1} respectively. Whereas there was no difference in TN levels between the SR and GM groups, the SOC levels (at 10.94 and 10.64 g.kg^{-1}) were substantially higher than the CK levels.

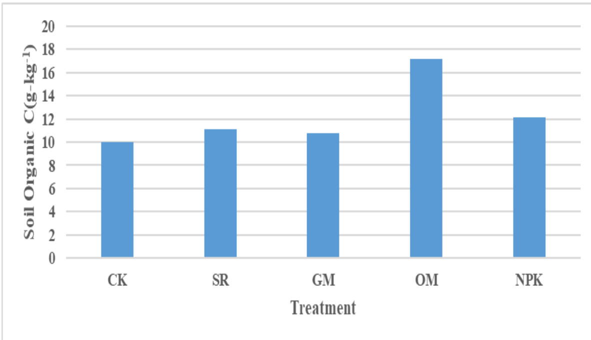

Fig 3.

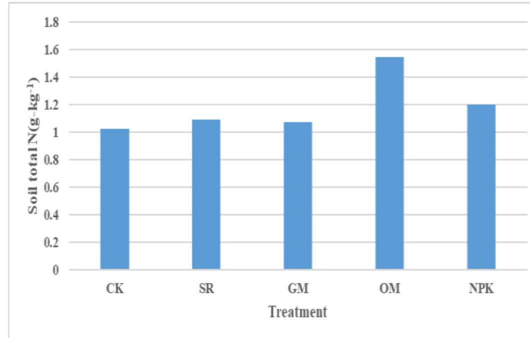

Fig 3a.

SOC trends in various treatments were comparable (Fig.4A). The SOC raised from 9.65–9.78 g.kg^{-1} in 2016 to 11.51–20.00 g.kg^{-1} in 2022 owing to fertilization. SOC content plummeted but stabilized. OM had the highest SOC content throughout the trial, whereas CK's remained consistent (approximately 10 g.kg^{-1}). During 2016-2022, the five treatments' TN content trends mirrored SOC (Fig. 4B). TN content increased quickly in the first several years in OM (from 1.01 to 1.76 g.kg^{-1}) and NPK (1.02 to 1.33). Both dropped and then stabilized. SR, GM, and CK soil TN concentrations were stable at 1.05 g.kg^{-1}

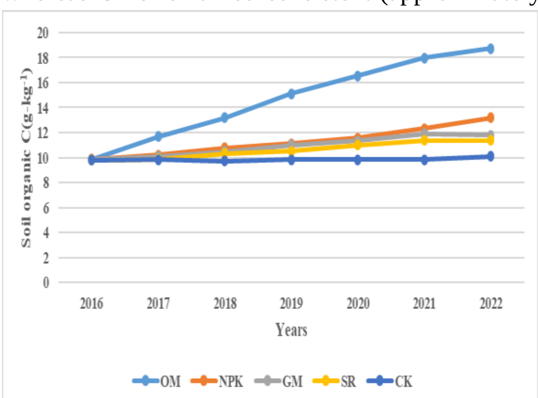

Fig 4(a).

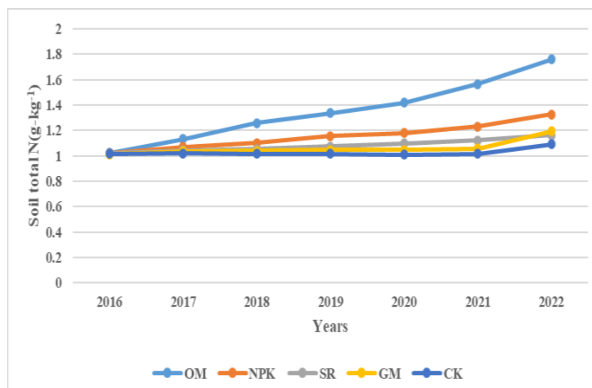

Fig 4(b).

CONCLUSION

In conclusion, fertilization treatments significantly affected soil fertility in the Betul district region soil area. OM and NPK raised SOC, TN, C/N ratios, AN, & 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. SOC, TN, and C/N ratios were all kept constant by continuous SR. Compared to CK, GM has little impact on soil fertility. Thus, considering soil K concentration, organic manure and K fertilizer should be administered to boost soil fertility in this location. For long-term fertilizer efficiency, this trail section might use yearly straw returning application.

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