E-ISSN: 2618-0618
P-ISSN: 2618-060X
© Agronomy
www.agronomyjournals.com
2025; SP-8(2): 30-32
Received: 28-11-2024
Accepted: 06-01-2025

Bungdon Bliss Anal
School of Agriculture, ITM University, Gwalior, Madhya Pradesh, India

Vipin Kumar
School of Agriculture, ITM University, Gwalior, Madhya Pradesh, India

Gopal Kumar
School of Agriculture, ITM University, Gwalior, Madhya Pradesh, India

Corresponding Author:
Bungdon Bliss Anal
School of Agriculture, ITM University, Gwalior, Madhya Pradesh, India

Availability of N P K under paddy-chick pea/pea-moong cropping system in Gwalior district of Madhya Pradesh

Bungdon Bliss Anal, Vipin Kumar and Gopal Kumar

DOI: https://doi.org/10.33545/2618060X.2025.v8.i2Sa.2515

Abstract
This study investigates the availability of essential macronutrients-Nitrogen (N), Phosphorus (P), and Potassium (K), pH, Electrical conductivity (EC) and organic carbon of soil under the Paddy-Chickpea Pea/Pea-Moong cropping system in the Gwalior district of Madhya Pradesh. The soil samples were collected from the four blocks of Gwalior district namely Morar, Ghatigoan, Dabra and Bhitarwar. The soil samples were analyzed in the Soil Science Laboratory, ITM University, and Gwalior. The results revealed that the soil of this area was neutral to slightly alkaline in reaction, low in organic carbon, low to medium in available nitrogen, low to high in available phosphorus and medium to high in available potassium with a normal electrical conductivity < 1 dS m^{-1}.

Keywords: Macronutrients, electrical conductivity, organic compound, pH

Introduction
Soil is a fundamental resource for agriculture, directly influencing crop productivity and sustainability. Soil characterization, which involves the detailed analysis of soil's physical and chemical properties, is essential for effective soil management. This process helps identify soil health issues, nutrient deficiencies, and the overall suitability of the soil for various crops. Gwalior district, located in the northern part of Madhya Pradesh, India, is an important agricultural hub due to its diverse agro-climatic conditions. The district experiences a semi-arid climate with distinct seasons and variable rainfall patterns, affecting agricultural practices and cropping systems. Farmers in Gwalior adopt various cropping systems, including monoculture, crop rotation, intercropping, and mixed cropping, each influenced by soil type, water availability, market demands, and traditional practices. These systems impact soil properties, affecting fertility, structure, and biological activity. Continuous practice of cereal-cereal rotations in the Indo-Gangetic Plains (IGP) of India has led to nutrient imbalances, soil degradation, and increased pest pressure, as noted by researchers Ladha *et al*. (2003) [6] and Chauhan *et al*. (2012) [2]. This trend is worsening crop productivity in the region. With better access to irrigation, farmers in the IGP prefer input-responsive cereals over other crops, like pulses, worsening low crop diversification issues (Ali and Gupta, 2012) [1]. Sustainable soil management is crucial for maintaining productivity. Technologies that increase soil organic matter, enhance biological activity, reduce salinity, and improve soil physical conditions are necessary. Introducing green manuring (such as Dhaincha: *Sesbania bispinosa*) and leguminous crops into existing cropping systems can improve soil fertility and productivity sustainably. For instance, in rice tracts where soils are slightly alkaline, green manure can reduce soil pH, improve fertility, structure, porosity, and water-holding capacity, and reduce the need for nitrogen fertilizers in rice cultivation. Green manuring, part of integrated nutrient management, enhances fertilizer efficiency and raises soil organic matter, improving the availability of other nutrients (Salim *et al*., 2005) [10]. Globally, rotating crops like chickpea, mung bean, sunflower, lentil, cowpeas, wheat, barley, maize, brassica, and vegetables with rice has proven to increase crop productivity, soil fertility, and resource use efficiency. Effective soil management and diverse cropping systems are essential for sustaining agricultural productivity and soil health in regions like Gwalior and the broader IGP.

Materials and Methods

The study area falls in Gwalior district of Madhya Pradesh. The area is situated at latitude of 26.218287°N and longitude of 8.182831°E at an altitude of 197 meter above the mean sea level (MSI). Soil samples were collected using GPS location, with the help of an auger at the harvesting stage of different crops and stored in polythene bags. After bringing to the laboratory each soil sample was air-dried on a layer of filter paper. Then dried samples were once more cleaned off for stones and plant residues. The soil samples were kept in for at least 5 days before being tested collected soil samples were then crushed gently with a wooden roller and then pass through a 2.0 mm sieve to obtain a uniform representative sample. Samples were properly labeled and carefully stored in polythene bags for analysis. The processed soil samples were analyzed by standard methods for pH and electrical conductivity (1:2 soil water suspensions), organic matter (Walkley and Black, 1934) [17], available nitrogen (Subbiah and Asija, 1956) [14], available phosphorus, available potassium (Jackson, 1973) [3]. All the analytical work was carried out in the laboratory of the Department of Soil Science, School of Agriculture, ITM University, and Gwalior, India.

Rating for Soil Samples

Soil samples were classified into low, medium and high categories as per the limits suggested by Singh *et al.* (2005) [13] for organic carbon, available nitrogen, phosphorus and potassium. The ratings for available micronutrients were followed by Lindsay and Norvell (1978) [7], respectively. The ratings for soil reaction (pH) were followed as communicated by the United States Department of Agriculture USDA (2017) [15]. The ratings of electrical conductivity (EC) were followed by Patil and Mali (1999) [9].

Table 1: Soil reaction classes

S. No.	Category	pH range	Classes are given by
1.	Slightly acidic	6.1 – 6.5	USDA (2017) [15]
2.	Neutral	6.6 – 7.3	
3.	Slightly alkaline	7.4 – 7.8	
4.	Moderately alkaline	7.9 – 8.4	
5.	Strongly alkaline	8.5 – 9.0	

Table 2: Salinity (Electrical conductivity) classes

S. No.	Salinity class	EC (dS m^{-1})	Classes are given by **Patil** and **Mali (1999)** [9]
1.	Normal	< 1	Patil and Mali (1999) [9]
2.	Slightly saline	1 – 2	
3.	Moderately saline	2 – 3	
4.	Highly saline	> 3	

Table 3: Rating chart for organic carbon and available nutrients

S. No	Nutrient	Low	Medium	High	Limit proposed by
1.	Organic carbon (%)	< 0.5	0.51 – 0.75	> 0.75	Singh *et al.* (2005) [13]
2.	Available N (kg ha^{-1})	< 280	281 - 560	> 560	
3.	Available P (kg ha^{-1})	< 10	11 - 25	> 25	
4.	Available K (kg ha^{-1})	< 120	121 - 280	> 280	

Results and Discussion

The present investigation entitled "Availability of N P K under Paddy-Chick Pea/Pea-Moong cropping system in Gwalior district of Madhya Pradesh" was carried out by collecting soil samples at the surface (0-15 cm) different locations of the study area. The soil samples were analyzed for the electro-chemical properties i.e. pH, electrical conductivity, organic carbon, available macronutrient (N, P, K).

Electro- chemical properties

Under Paddy-Chick Pea/Pea-Moong cropping system, the soil pH value varied from 7.26 - 7.87 with the mean 7.49, respectively. Most of the soils were in a slightly alkaline range, a similar result was earlier reported by Singh and Wanjari, 2013 [11] and Singh *etal.*, 2008 [12].

Electrical conductivity in 1:2.5 soil-water suspensions for soils at different locations of Paddy-Chick Pea/Pea-Moong cropping system. Under the cropping system the soil EC ranged from 0.33 - 0.52 dSm-1 with an average value of 0.39 dSm-1. All the soils were in the normal range concerning EC indicating the non-saline nature of the soil. The low EC may be due to free drainage conditions which favored the removal of released bases by percolating and drainage water. Similar results were reported by Kumar *etal*, 2014 [4] and Kumar*et al.*, 2017 [5].

In Paddy - Chick Pea/ Pea - Moong cropping system the organic carbon content in soil varied from 0.36 - 0.42 percent with an average value of 0.39 percent respectively. Based on the rating suggested by Singh *et al*. (2005) [13], soil samples were low in organic carbon status at surface. The low organic matter content in soils might be attributed to the prevalence of the tropical condition, where the degradation of organic matter occurs at a faster rate coupled with low vegetation cover, thereby leaving less organic carbon in the soils. Similar results were reported by Nayak *et al*. (2002) [8] and Verma *etal*., 2008 [16].

Table 4: pH, EC and OC of the soils of the four blocks of Gwalior under Paddy - Chick Pea/ Pea - Moong cropping system**.**

Location	pH	Electrical conductivity	Organic compound
Morar	7.26	0.34	0.36
Ghatigoan	7.33	0.33	0.42
Dabra	7.87	0.52	0.38
Bhitarwar	7.48	0.35	0.41

Nutrient status

Available nitrogen estimated in the soils surface (0-15 cm) varied from 178.98- 203.41kg ha^{-1} with an average value of 192.28 kg ha^{-1} which was found in the low based on the rating suggested by Singh *et al.* (2005) [13].

Available phosphorus varied from 20.51 - 25.02 kg ha^{-1} with an average value of 22.96 kg ha^{-1} which was found in medium-range 11 - 25 kg ha^{-1} according to Singh *et al.* (2005) [13].

Available potassium varied from 259.25 - 387.12 kg ha^{-1} with an average value of 329.45 kg ha^{-1} which was high in potassium fertility status based on the rating suggested by Singh *et al.* (2005) [13].

Table 5: Variability of NPK under different locations under Paddy - Chick Pea/ Pea - Moong cropping system**.**

Location	N	P	K
Morar	187.85	22.84	387.12
Ghatigoan	178.98	2.51	287.23
Dabra	203.41	23.45	259.25
Bhitarwar	198.89	25.02	384.21

Conclusion

The study on soil fertility under the Paddy-Chickpea/Pea-Moong cropping system in Gwalior district reveals that soils are neutral to slightly alkaline and non-saline, with low organic carbon content. Nitrogen levels are notably low, phosphorus is moderate, and potassium is high. These findings highlight a need for targeted nitrogen and phosphorus management to improve

soil fertility and crop productivity. Implementing practices like green manuring and organic amendments could effectively address these nutrient imbalances and enhance sustainable agricultural practices in the region.

Acknowledgments
The authors sincerely appreciate the Department of Soil Science and the School of Agricultural (SoAG), ITM University, Gwalior, for providing the necessary laboratory facilities for this study.

References

1. Ali M, Gupta S. Carrying capacity of Indian agriculture: pulse crops. Curr Sci. 2012;874-881.
2. Chauhan BS, Singh RG, Mahajan G. Ecology and management of weeds under conservation agriculture: a review. Crop Prot. 2012;38:57-65.
3. Jackson ML. Soil chemical analysis. New Delhi: Prentice Hall of India Pvt. Ltd.; 1973.
4. Kumar S, Kumar V, Dhyani BP, Kumar A, Kumar R, Kumar P, *et al*. Nutrient status of sugarcane-wheat growing soils of Daurala Block of Gwalior district, Uttar Pradesh. J Plant Dev Sci. 2014;6(1):51-55.
5. Kumar A, Srivastava LK, Mishra VN, Banwasi R. Major and micronutrient status of rice-chickpea grown in soils of Chhattisgarh plain region of India. Indian J Agric Res. 2017;51(1):1-8.
6. Ladha JK, Pathak H, Tirol Padre A, Dawe D, Gupta RK. Productivity trends in intensive rice-wheat cropping systems in Asia. In: Improving the productivity and sustainability of rice-wheat systems: issues and impacts. Madison, Wisconsin: USA: Agronomy series ASA-CSSA-SSSA Publishers; 2002. p. 45-76.
7. Lindsay WL, Norvell WA. Development of a DTPA soil test for micronutrient. Soil Sci Soc Am J. 1978;42:421-428.
8. Nayak AK, Babu SK, Choudhury SG, Tripathi R, Shahid M, Panda B, Kumar U. Effect of integrated nutrient management on soil organic carbon and its fractions in a tropical rice–rice system. Nutr Cycl Agroecosyst. 2002;95(2):175-188.
9. Patil VD, Mali CV. Soil fertility and crop productivity: A comparative study of some soils. J Indian Soc Soil Sci. 1999;47(2):282-286.
10. Salim N, Raza A. Nutrient use efficiency (NUE) for sustainable wheat production: a review. J Plant Nutr. 2020;43(2):297-315.
11. Singh MV, Wanjari RH. Soil properties and fertility management in relation to sustainable agricultural production. 2013.
12. Singh RK, Singh SK, Tarafdar JC. Influence of cropping sequence and nutrient management on soil organic carbon and nutrient status of typical Rhodustalalls. J Indian Soc Soil Sci. 2008;56:174-181.
13. Singh M, Rao G, Ramesh S. Effects of nitrogen, phosphorus, and potassium on herbage, oil yield, oil quality, and soil fertility status of lemongrass in a semi-arid tropical region of India. J Hortic Sci Biotechnol. 2005;80(4):493-497.
14. Subbiah BV, Asija GL. A rapid procedure for the estimation of available nitrogen in soils. Curr Sci. 1956;25:259-260.
15. USDA. Soil pH guidelines. United States Department of Agriculture; 2017.
16. Verma TS, Sharma PK, Raina P. Soil organic carbon and its fractions in relation to cropping sequences in north-western Himalayas. Indian J Agric Sci. 2008;78(2):123-126.
17. Walkley A, Black IA. An examination of the Degtjareff method for determining soil organic matter and proposed modification of the chromic acid titration method. J Soil Sci. 1934;37:29-38.