Influence of Integrated Nutrient Management with Foliar Application of Mono Potassium Phosphate on Soil Health in Cultivation of Cowpea (*Vigna unguiculate L.*) var. Mohini 34

ABSTRACT

The study titled "Influence of Integrated Nutrient Management with Foliar Application of Mono Potassium Phosphate on Soil Health in cultivation of Cowpea (Vigna unguiculate L.) var. Mohini 34" was conducted during the Kharif season of 2023-24 at the Soil Science Crop Research Farm, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj. The experiment was arranged in a Randomized Block Design with three replications. The investigation focused on the impact of various treatments on soil health. The findings revealed several significant outcomes: Regarding soil health parameters, the application of integrated nutrient management (INM) and foliar application of Mono Potassium Phosphate (MKP) influenced bulk density, particle density, pore space, water retaining capacity, pH, electrical conductivity (EC), organic carbon content, as well as nitrogen, phosphorus, and potassium levels in the soil. Notably, certain treatments led to a decrease in bulk density and EC, while enhancing organic carbon content and nutrient availability in the soil. In conclusion, the study underscores the importance of integrated nutrient management practices, including foliar application of MKP, in enhancing soil health parameters. These findings provide valuable insights for sustainable agricultural practices aimed at optimizing crop productivity while preserving soil health.

Keywords: Soil Health, Integrated Nutrient Management, Foliar Application, Mono Potassium Phosphate, Sustainable Agriculture, Crop Productivity etc.

1. INTRODUCTION

Soil is a dynamic non-renewable natural resource that is vital to life. Soil fertility is the capacity of the soil to provide all the nutrients required by plants in easily accessible forms and in the right amounts; on the other hand, soil productivity is the result of several factors, such as soil fertility, effective soil management practices, the availability of water supplies, and a suitable climate. Cowpea (*Vigna unguiculata L.*) is a poor's men's protein source. It is among the oldest food sources for humans and was most likely cultivated as a crop plant as early as the Neolithic era (Ng & Marechal, 1985)(1). It is a significant multipurpose grain legume that is widely grown in the tropics' semiarid and dry regions. It is a valuable source of nutrients and gives diets heavy in cereal grains and starchy foods high-quality, reasonably priced protein.

The goal of integrated nutrient management is to manage all sources of organic, inorganic, and biological components in an integrated way in order to maintain soil fertility and plant nutrient supply at an optimal level for maintaining the desired productivity. Thus, integrated nutrient management should encourage the efficient use of all nutrient sources, including organic sources, recyclable wastes, mineral fertilizers, and bio-fertilizers (Roy *et al.*, 2006)(2).

Nitrogen is essential for many metabolic processes involved in plant growth. According to (Meena *et al*., 2014)(3), nitrogen is a necessary component of both protein and chlorophyll. Nitrogen and Phosphorous stimulate crop root activity and rooting patterns, enabling seedlings to start well before nitrogen fixation. Potassium is essential for plant growth, photosynthesis, enzyme activity, protein, carbohydrate, fat synthesis, and pest resistance. Plants fed organic nitrogen grow larger by flowering. Vermicompost, a mixture of earthworm castings, organic materials, and other organisms, is a popular organic compost and substitute for chemical fertilizer in organic farming. It is a recent innovation in composting technology and has been advocated for integrated nutrient management in field crops, such as cowpea, to reduce cultivation costs, maintain soil health, and boost yield. Biofertilizers are small microbes which can be created by containing living cells of nitrogen fixing and phosphate solubilizing microorganism for treatment of seed or soil.

2. METHODOLOGY

The field experiment take place at the central research farm of the department of soil science and agricultural chemistry at the Naini Agricultural Institute, Prayagraj (Allahabad) 211 007, (U.P.), during the Kharif season in 2022. The farm is situated at 98 meters above mean sea level and at 25°24'30" North latitude and 81°51'10" East longitude. standing in for the Agro-climatic zone (Upper Gangetic Plain Region) and the Agro-ecological subregion (North Alluvium Plain Zone, 0-1% Slope).

Argo Climatically, Prayagraj district represents the subtropical belt of the South East of (U.P.) and is endowed with extremely hot summer and fairly cold winter. The location's maximum temperature is 46°C, with rare dips below 4°C or 5°C. There is a 20–94% relative humidity range. This area receives approximately 1100 mm of rain on average each year.

The soil samples were randomly collected from one site in the experiment plot prior to tillageoperation from a depth of 0-15 cm. The volume of the soil sample will be reduced by conning and quartering the composites soilsample will be air dried and passed through a 2 mm sieve by way of preparing the sample for physical analysis, bulk density, particle density,pore space %, water holding capacity % (4) and chemical analysis, Ph(5), EC (6), organic carbon (7), available nitrogen (8), phosphorus (9), and potassium (10).

Table 1. Treatment combination of Cowpea var. Mohini 34

S. No.	Treatment combination
T_1	Farmers Recommended Dose,
T_2	(0% VC + 50%RDF+ 50% BF + Foliar application of WSF),
T_3	(0% VC + 100%RDF+ 100% BF + Foliar application of WSF),
T_4	(50% VC + 0%RDF+ 0% BF+ Foliar application of WSF),
T_5	(50% VC + 50%RDF+ 50% BF + Foliar application of WSF),
T_6	(50% VC + 100% RDF+ 100% BF+ Foliar application of WSF),
T_7	(100% VC + 0% RDF+ 0% BF+ Foliar application of WSF),
T_8	(100% VC + 0% RDF+ 0% BF+ Foliar application of WSF),
T_9	(100% VC + 0% RDF+ 0% BF+ Foliar application of WSF).

VC= Vermicompost, RDF (Recommended Dose of Fertilizer-20 kg N, 50-60 kg/ha P2O5, 50-60 kg /ha K2O), BF= Biofertilizer (Azotobacter), Water Soluble Fertilizer : M.K.P. (0:52:34)

3. RESULTS AND DISCUSSION

The study investigated the impact of various nutrient management treatments on key soil health parameters. The results are summarized below, with a focus on bulk density, particle density, pore space, water retaining capacity, pH, electrical conductivity (EC), organic carbon, and the availability of nitrogen (N), phosphorus (P), and potassium (K).
The application of both inorganic and organic sources of nutrients, along with biofertilizers, had a non-significant effect on soil bulk density. However, it was generally observed that Integrated Nutrient Management (INM) tends to decrease soil bulk density. The minimum bulk density (1.25 Mg m^{-3}) was recorded in treatment T9(100% VC + 0% RDF+ 0% BF+ Foliar application of WSF). Similar to bulk density, the particle density of soil did not show significant variations across different treatments. The particle density values ranged from 2.3 to 2.5 Mg m^{-3} at a 0-15 cm depth. The percentage of pore space was not significantly affected by the different treatments. However, treatment T9 recorded the maximum pore space at 47.90%. This suggests that the integrated use of organic and inorganic nutrients along with biofertilizers can enhance soil structure, potentially increasing pore space. There was no significant effect on the water retaining capacity across different treatments. The maximum water retaining capacity (46.10%) was recorded in treatment T9, while the minimum (43.30%) was observed in the control treatment (T1). Biofertilizers may improve soil structure and increase the number of soil pores, thereby enhancing water retention. The soil pH values did not show significant differences after the harvest of cowpea due to the treatments applied. However, the maximum reduction in soil pH was noted in treatment T9, indicating a slight acidifying effect of the applied treatments. A significant difference in soil EC was observed across different treatments. The EC generally decreased compared to the control, with the maximum reduction recorded in treatment T1 (absolute control). This reduction in EC could be attributed to the dilution effect of increased organic matter and microbial activity from biofertilizers. The organic carbon content in the soil showed significant differences across treatments. Treatment T9 recorded the highest organic carbon content (0.47%),

while the control treatment (T1) had the lowest (0.39%). The results indicate that combining RDF with vermicompost and biofertilizers significantly enhances soil organic carbon levels. The nitrogen content in the soil increased across all treatments compared to the control. The highest nitrogen content was recorded in treatment T9(100% VC + 0% RDF+ 0% BF+ Foliar application of WSF). The buildup of available phosphorus was highest in treatment T9, closely followed by treatment T8 (100% VC + 0% RDF+ 0% BF+ Foliar application of WSF). This indicates that the combined application of RDF, vermicompost, and biofertilizers positively impacts the availability of phosphorus in the soil. The highest buildup of available potassium was observed in treatment T9, closely followed by treatment T8. The control treatment had the lowest potassium levels. The results demonstrate that the integrated application of inorganic fertilizers, vermicompost, and biofertilizers, along with foliar application of WSF, significantly enhances soil potassium availability.

Table 2. Effect of Integrated Nutrient Management with foliar application of WSF on physical properties of soil.

Treatment	**Bulk density ($Mg\ m^{-3}$)**	**Particle density ($Mg\ m^{-3}$)**	**Pore space (%)**	**Water holding Capacity (%)**
	(0-15cm)	**(0-15cm)**	**(0-15cm)**	**(0-15cm)**
T_1	1.26	2.42	46.29	43.3
T_2	1.32	2.3	47.22	43.88
T_3	1.3	2.38	47.4	44.22
T_4	1.3	2.4	47.19	43.4
T_5	1.29	2.43	47.4	45.46
T_6	1.28	2.45	47.82	45.47
T_7	1.28	2.47	47.19	44.22
T_8	1.27	2.47	47.5	45.42
T_9	1.25	2.5	47.9	46.1
F-test	NS	NS	NS	NS
S.Ed. (±)	-	-	-	-
C.D.@5%	-	-	-	-

Fig.1. Effect of Integrated Nutrient Management with foliar application of WSF on physical properties of soil.

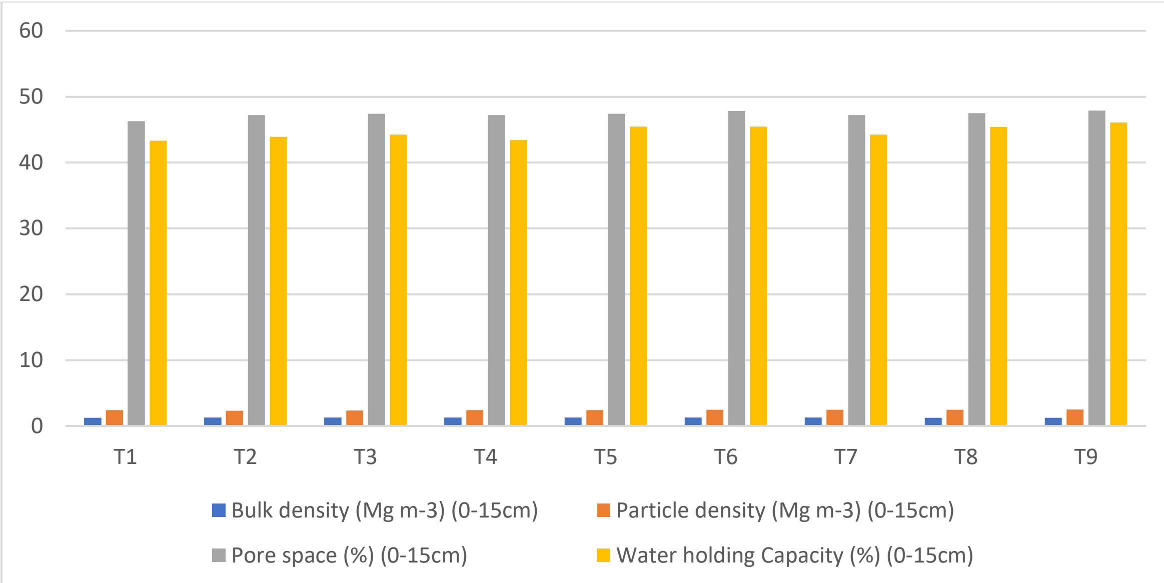
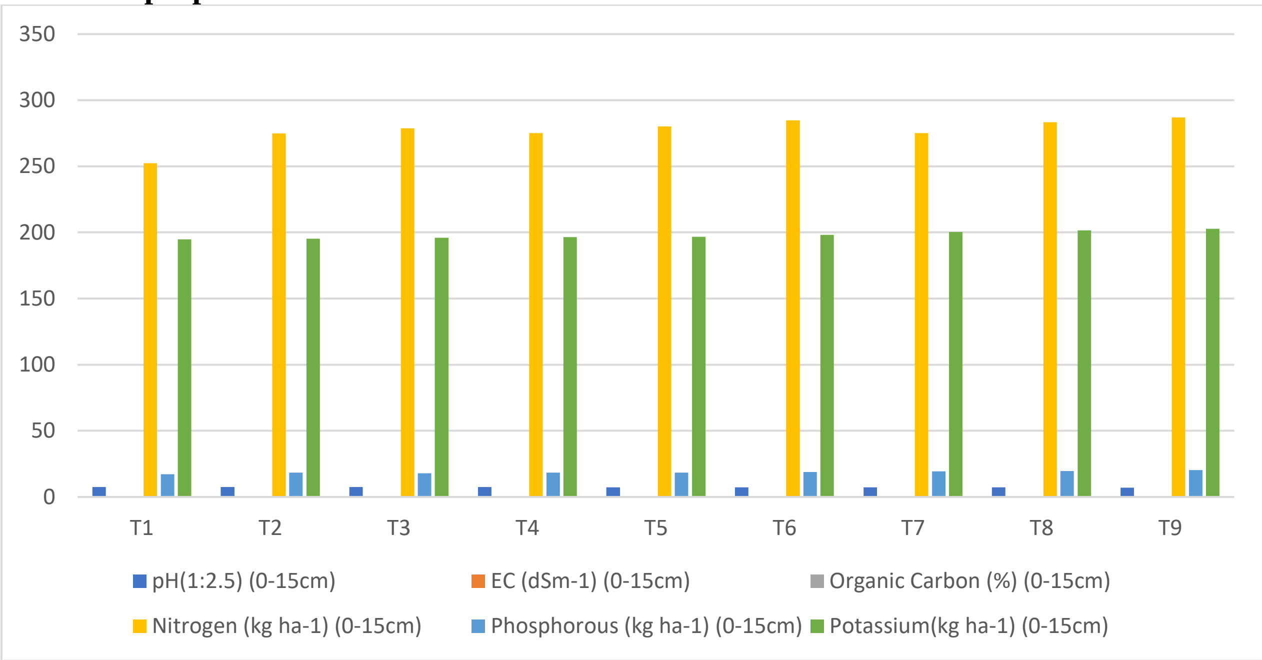


Table 3. Effect of Integrated Nutrient Management with foliar application of WSF on chemical properties of soil.

Treatment	pH(1:2.5)	EC (dSm^{-1})	Organic Carbon (%)	Nitrogen (kg ha^{-1})	Phosphorous (kg ha^{-1})	Potassium (kg ha^{-1})
	(0-15cm)	(0-15cm)	(0-15cm)	(0-15cm)	(0-15cm)	(0-15cm)
T_1	7.37	0.36	0.39	252.5	17.22	194.7
T_2	7.4	0.39	0.4	274.9	18.36	195.2
T_3	7.42	0.42	0.41	278.7	17.84	195.9
T_4	7.39	0.44	0.42	275.2	18.42	196.4
T_5	7.33	0.42	0.43	280.3	18.36	196.8
T_6	7.27	0.4	0.44	284.9	18.77	198.3
T_7	7.2	0.41	0.43	275.2	19.23	200.3
T_8	7.16	0.47	0.45	283.4	19.57	201.5
T_9	7.06	0.49	0.47	287	20.22	202.9
F-test	NS	S	S	S	S	NS
S.Ed. (±)	-	0.007	0.01	4.27	0.36	-
C.D.@5%	-	0.01	0.02	9.06	0.76	-

Fig.2. Effect of Integrated Nutrient Management with foliar application of WSF on

chemical properties of soil.



4. CONCLUSION

The application of integrated nutrient management strategies, combining inorganic and organic sources with biofertilizers, has a substantial impact on improving various soil health parameters. Although some parameters like bulk density, particle density, pore space, and water retaining capacity did not show significant changes, the overall trend suggests improvements in soil structure and nutrient availability. The significant increases in organic carbon, nitrogen, phosphorus, and potassium highlight the potential of these integrated approaches to enhance soil fertility and sustainability. Treatment T9 (100% VC + 100% RDF + 100% BF + Foliar application of WSF) consistently showed the most beneficial effects, making it a promising strategy for maintaining soil health in agricultural practices.

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