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A Comparative Account of Nutrient Profile of Organic and Chemical-Fertilized Agricultural Fields of the Kota Region of Bilaspur District

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Abstract: ***Malnutrition and contamination of soil are a worldwide concern in agriculture fields. The chemical fertilizer can overcome malnutrition but parallel its long-term and excessive use causes soil contamination when crossing the recommended range. Contradictory, the organic fertilizers serve for soil richness; therefore it enters into agriculture practices. The present market trends are now favoring organic fertilizers due to their contribution to rich soil nutritional value. Organic manures are crucial to improving soil quality with augmented crop yield. The blend of organic and inorganic fertilizers also is found significant in a higher rate of crop yield. The present research work could be extended toward the microbiological profile of soil with organic fertilizers in agriculture fields.***

Keywords: Organic agriculture fields, chemical fertilizer, organic fertilizer, organic manure, malnutrition

1. Introduction

The soil serves as a vital fraction of the agriculture ecosystem that nourishes crops and soil microbiota. The farmers maintain soil fertility using organic and synthetic chemical based-fertilizers. Organic fertilizers are synthesized from waste biomass whereas chemical fertilizers consisted of chemically synthesized inorganic compounds and certain minerals. Chemical fertilizers are extensively used to enrich soil fertility and enhance crop yield. Besides its rapid effect on soil fertility, the disproportionate use of chemical fertilizer in agriculture fields causes soil acidification and soil crust which promotes organic content depletion and altered pH which leads to a reduction of soil nutrient profile.

Farmers often cultivate wheat and rice cereal crops worldwide. The farmers of Chhattisgarh state cultivate rice in larger segments of crop fields. Recently, Chhattisgarh state acquires a second position in the central rice distribution pool (driven by the Food Corporation of India). About 2514456 farmers are registered under C.G. government paddy procurement by cooperative societies. The crop field is often fertilized by synthetic inorganic fertilizers (SIF). The pieces of literature claimed that the excessive use of such SIF may harm the physiochemical and biological fertility of the soil (Kumar et al., 1019; Farhad et al. 2018). Soil fertility severely affects crop quality. Contradictory, organic fertilizers (OF) seem to be promising to uplift soil fertility and farmers are adapting OF to ensure a significant nutritional supply in the soil system (Ilahi et al., 2021; Hai et al. 2010; Fuertes Mendizabal et al. 2010; Bahrman et al. 2004). The findings of the literature revealed that organic fertilizers are rich in absorbable minerals and vitamin contents than those crop fields that are fertilized with SIF (Shivay et al., 2010). Organic farming has got attention due to high-quality crops with the minimum rate of harmful impact on the human body (Rodrigues et al. 2006). As the demand increases the organic fertilizer manufacturer offers a high price to the farmer's communities (Delate and Camberdella 2004) which needs to be controlled by the government bodies.

Besides, organic fertilizers are composed of small nutrient-rich bioactive organic materials that are able to bind with soil particles and offer plants bioactive soil aggregates (BSA). This BSA is encourage the growth of plant growth-promoting rhizobacteria (PGPR), enhances nutrient absorption rate by plants or crops, and increases the water retention efficacy of soil. Soil fertility is measured based on soil moisture content, soil porosity, microbial density in soil, humic acid content, and organic and inorganic profile of soil (Abbas et al. 2012; Meagy et al. 2016). The availability of nutrients in the soil is affected by pH and microbial flora (Kalsoom et al., 2020). Microbes i.e., bacteria, fungi, archaea, and viruses, reside in the soil and are playing a vital role in maintaining a healthy soil ecosystem (Rehman et al., 2020; Toor et al., 2020) and in abiogeochemical cycle of soil (Ilahi etal., 2020; Tamilselvi et al., 2015).

The long-term use of chemical fertilizers has been found to be detrimental to soil profile (Galloway et al. 2008). Hence, organic fertilizers with no harmful impact on soil microbiota get consideration among farmers. Thereby, the present research work was emphasized to assess the nutrient profile of organic - and chemical-fertilized agricultural fields of the Kota region of Bilaspur District. The present study helps the farmer with an effective selection of organic- and chemical- fertilizers for crop fields. A sufficient number of pieces of literature have been available to support both organic and chemical fertilizers so the present research outcome could be able to answer the

nutrient parameter-based effective selection of fertilizers for the farmers.

Wheat is the most important cereal crop worldwide and meets about two-third of the protein-energy needs of the world population (Cakmak2009). It is grown organically as well as inorganically. The demand of organically grown wheat is increasing in the world due to its high nutritional value (Hai et al. 2010; White and Broadley2009) since organically produced foods are usually considered to have a better taste, better balanced vitamins and minerals than those conventionally grown (Fuertes- Mendizabal et al. 2010). Protein contents in wheat grains grown by organic fertilizers are higher than in those grown by chemical fertilizers (Bahrman et al. 2004; Shivay, Prasad, and Rahal 2010). Organic farming has received attention during the last two decades due to its high-quality products (Farhad et al. 2018; Rodrigues et al. 2006), high price, and low market availability of inorganic fertilizers, especially in developing countries like Pakistan. Certified organic grains have higher values than inorganic products (Delate and Camberdella2004). Similarly, organic cropping system has higher nutrient use efficiency than conventional system (Hildermann et al. 2010). In contrast to Wheat is the most important cereal crop worldwide and meets about two-third of the protein-energy needs of the world population (Cakmak2009). It is grown organically as well as inorganically. The demand of organically grown wheat is increasing in the world due to its high nutritional value (Hai et al. 2010; White and Broadley 2009) since organically produced foods are usually considered to have a better taste, better balanced vitamins and minerals than those conventionally grown (Fuertes- Mendizabal et al. 2010). Protein contents in wheat grains grown by organic fertilizers are higher than in those grown by chemical fertilizers (Bahrman et al. 2004; Shivay, Prasad, and Rahal 2010). Organic farming has received attention during the last two decades due to its high-quality products (Farhad et al. 2018; Rodrigues et al. 2006), high price, and low market availability of inorganic fertilizers, especially in developing countries like Pakistan. Certified organic grains have higher values than inorganic products (Delate and Camberdella2004). Similarly, organic cropping system has higher nutrient use efficiency than conventional system (Hildermann et al. 2010).

2. Materials and Methods

The agricultural crop fields of the Kota region were surveyed and divided into two groups. Group-I consisted of chemical-fertilized crop fields while Group-II consisted of organic each group had three sectors and further each sector was divided into five sites. The soil samples were collected from 3.0 cm below from soil surface of the organic- and chemical-fertilized agricultural fields of the Kota region of Bilaspur District in a clean polybag. The samples were brought to the laboratory for nutrient profile analysis. The pH, Electrical Conductivity (Ec, dS/m), Organic carbon (OC, %), Nitrogen (N, Kg/Hec), Phosphorus (P, Kg/Hec), Potassium (K, Kg/Hec), Sulfur (S, Kg/Hec), Zinc (Zn, ppm), Boron (B, ppm), Iron (Fe, ppm), Manganese (Mn, ppm), copper (Cu, ppm) was assessed by standard protocol suggested in the manual released by the Department of Agriculture & Cooperation Ministry of Agriculture, New Delhi (2011).

3. Result and Discussion

A comparative nutrient profile of organic- and chemical-fertilized agricultural fields of the Kota region of Bilaspur District was assessed. An average pH, electrical conductivity (dS/m), and organic carbon (%) were observed at 7.98, 0.42, and 0.86 for organically fertilized crop fields (OFCFs) while 6.48, 0.38, and 0.5 for chemically fertilized crop fields (CFCFs). An average Macronutrients i.e., Nitrogen (N, kg/hec), P (kg/hec), K(kg/hec), S (kg/hec), and, micronutrients i.e., Zn (ppm), B (ppm), Fe (ppm), Mn (ppm) and Cu (ppm) were observed252.86, 16.42, 352.73, 15, 0.77, 5.53, 25.95, 25.61 and 1.19 for CFCFs (Table 1) while 271.93, 21.08, 446.8, 23.41, 1.33, 4.26, 18.80, 25.38, 1.33for OFCFs (Table 2).

Agriculture Development and Farmer Welfare and Bio-Technology Department (ADFWBD) recommended for authorized soil testing laboratories are mentioned in Table 3. The observation revealed that the OFCFs soil has slightly alkaline pH ranges between 7.96 to 8.0, EC under recommended range, significant OC (ranges between 0.81 to 0.9 %), N values were observed satisfactory only for soil sample B (315.2 Kg/Hec), P values were satisfactory, K values was broke the recommended range (found between 436.4 to 454.2), sulfur was found in the sufficient range between 21 to 25 Kg/Hec, the micronutrients (Zn, B, Fe, Mn, and Cu) were observed sufficient. When comparing the OFCFs and CFCFs, all the macronutrients and micronutrients were noted significantly higher in OFCFs except B (5 to 5.8 ppm in CFCFs), and Fe (23.11 to 30.96 ppm in CFCFs). The pH of CFCFs has been detected to be closer to recommended range than that of OFCFs (Table 3).Average macronutrients and micronutrient values of each sector of OFCFs and CFCFs are comparatively represented in Fig.1, Fig 2, and Table 3.

Department of Soil Science and Agricultural Chemistry, Sam Higginbottom University of Agriculture, Technology and Sciences- Allahabad 211007, U.P., India assessed Assessment and Characterization of Soil in Sarguja District, Chhattisgarh, India. They revealed that pH, EC value, OC%, available N, available P, available K, available S, and available zinc varied from 6.9 to 6.08, 0.335 to 0.142, 0.78% to 0.12%, 264 kg ha-1 to 173.4kg ha-1, 25.4 kg ha-1 to 10.5 kg ha-1, 110.4 kg ha-1 to 138 kg ha-1, 18.5to 9.6 ppm and 1.62 ppm to 0.8 ppm respectively which was (Tigga et al., 2017). The macronutrients i.e., N, P, and K were found in lower concentration while S and Zn were observed in the medium range. Similarly, Tirkey, E. D., Thomas, T. (2017) carried out a systematic investigation for chemical analysis of soil of the Korba district (C.G.) during 2016-17 and found that pH value, EC, OC, N, P, and K ranged from 6.03 - 7.41, 0.10 to 0.37 dSm-1, 0.42 to 0.64 %, 163.46 to 289.21 kg ha-1, 9.24 to 17.06 kg ha-1 and 216 to 397 kg ha-1 correspondingly.

Moreover, the Department of Soil Science and Agricultural Chemistry, Indira Gandhi Krishi Vishwavidayala, Raipur (C.G.) presented research data on soil fertility status of available major nutrients (N, P & K) and micronutrients (Fe, Mn, Cu & Zn) in Vertisol of Balodabazar block, Chhattisgarh during National Conference on Conservation Agriculture organized by ITM University, Gwalior on 22-23 February 2018. They disclosed that pH, EC, OC, available N content, P content, K content, Fe content, Zn content, Cu content, and Mn content ranges from 4.7 to 8 (mean value of 6.8), 0.10 to 0.70 dS m-1 (0.30 dS m-1), 0.30 to 0.75 % (mean value of 0.30), 105 to 263 kg ha-1 (mean values 197 kg ha-1), 1.5 to 34.9 kg ha-1 (mean value of 18.0 kgha-1), 115 to 643 kg ha-1(mean value of 417 kg ha-1), 2.40 to 44.12 mg kg-1 (mean values 16.46 kg ha-1), 0.20 to 3.00 mg kg-1 (mean value of 0.95 mg kg-1) and2.20 to 45.76 kg ha-1 (mean value of 23.85 kg ha-1) respectively for *Vertisol* group of Balodabazar block of Chhattisgarh based on the analysis carried out during 2016-17 (Singh et al., 2018). Another study was conducted on physicochemical parameters of soils of paddy fields, located in the NCPH(north chirimiriponri hill) colliery area of Koriya District and authors reported that the pH, E.C. OC, Available N (Kg/acre), Available P (Kg/acre), Available K (Kg/acre) of sampling sites ranged between 6.2 to 8.1, 0.15 to 0.40, 0.29 to 0.47, 125 to 164, 5.63 to 7.23, 63 to 180 respectively (Singh and Upadhayay, 2018).

Our observations also support the ranges of micro- and macro-nutrients mentioned in the previous works of literature. Most of the pieces of literature were not categorized crop fields based on the fertilizers types used (either organic or chemical fertilizers) i.e., their results were based on the geographical location as per experimental design or area of interest. International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), Patancheru (T.L.), Jawaharlal Nehru Krishi Vishwavidyalaya (JNKV), Jabalpur (M.P.) and Indira Gandhi Krishi Vishwavidyalaya (IGKV), Raipur (C.G.) have collaboratively assessed soil fertility status of the rain fed regions of Chhattisgarh and Madhya Pradesh and reported that study area has poor OC and available P content in the soil whereas sufficient K content (Ghosh et al., 2015).Our research work showed that N and P content were satisfactory, K content was more than recommended range and the rest of the nutrients were found satisfactory in crop fields. As per the resulting outcome of the present work, the macronutrients and micronutrients were significantly higher in OFCFs excluding B, and Fe.

The satisfactory nutrient content of organic fertilizers (OFs) makes OFs suitable for agriculture practices to make crop production cost-effective due to the lesser requirement of fortification in crop fields after adding OFs (Sharma and Chetani, 2017). OFs are well known to maintain long-term soil quality and eco-friendly approaches. Besides chemical fertilizers are quickly absorbed by plants and are recommended for rapid nourishment of malnutrition soil. Hence, the blended approach could be adopted to accomplish significant crop yield without harming the ecosystem.

4. Conclusion

Soil fertility is the prime concern in the agricultural field due to the excessive use of chemical fertilizers. Contradictory, the organic fertilizers serve for soil richness; therefore it enters into agriculture practices. The present market trends are now favoring organic fertilizers due to their contribution to rich soil nutritional value. Organic manures are crucial to improving soil quality with augmented crop yield. The blend of organic and inorganic fertilizers also is found significant in a higher rate of crop yield. The present research work could be extended toward the microbiological profile of soil with organic fertilizers in agriculture fields.

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Table 1: Chemically Fertilized Crop Fields (CFCFs)

Soil Sample	pH	EC (dS/m)	OC (%)	N (Kg/Hec)	P (Kg/Hec)	K (Kg/Hec)	S (Kg/Hec)	Zn (ppm)	B (ppm)	Fe (ppm)	Mn (ppm)	Cu (ppm)
A-1	7.1	0.3	0.9	225	16.12	380	20	1.364	8	13.91	41.42	0.864
A-2	6.2	0.5	0.9	188	12.54	392	13.75	0.792	7	20.33	9.401	3.012
A-3	6.1	0.4	0.3	225	10.75	369	12.5	1.101	3	18.63	4.369	1.032
A-4	5.3	0.3	0.45	300	25.08	380	13.75	0.562	4	22.4	40.11	0.736
A-Centre	5.9	0.3	0.45	326	25.08	380	17.5	0.402	3	40.3	33.3	0.934
B-1	5.7	0.4	0.15	188	5.37	358	15	0.342	8	14.36	13.27	0.765
B-2	8.4	0.3	0.3	200	10.75	358	15	0.739	3	27.33	18.29	0.901
B-3	5.7	0.3	0.6	276	14.33	302	11.25	0.361	5	31.9	36.4	2.011
B-4	7.6	0.5	0.3	225	22.4	358	13.75	1.036	4	14.73	11.43	0.894
B- Centre	5.9	0.5	0.6	338	11.64	336	13.75	0.612	9	30.57	33.57	0.671
C-1	6.3	0.3	0.3	276	18.81	291	16.25	1.346	5	31.36	31.23	0.346
C-2	5.5	0.4	0.45	276	8.96	392	20	0.402	8	39.42	30.6	1.036
C-3	7.3	0.4	0.15	250	8.06	380	12.5	1.064	7	30.52	12.35	1.046
C-4	6.2	0.5	0.75	250	28.67	347	17.5	0.749	3	13.4	32.1	0.711
C- Centre	8.1	0.3	0.9	250	27.77	268	12.5	0.811	6	40.11	36.42	3.036
Average	6.4	0.38	0.5	252.86	16.42	352.73	15	0.778	5.5	25.95	25.61	1.199

Table 2: Organic Fertilized Crop Fields (OFCFs)

Soil Sample	pH	EC (dS/m)	OC (%)	N (Kg/Hec)	P (Kg/Hec)	K (Kg/Hec)	S (Kg/Hec)	Zn (ppm)	B (ppm)	Fe (ppm)	Mn (ppm)	Cu (ppm)
A-1	8	0.4	0.75	250	25.08	448	25	1.042	4	31.31	18.34	1.256
A-2	8	0.4	0.75	238	26.88	459	22.5	1.364	4	36.15	25.11	1.324
A-3	8	0.4	0.9	225	11.64	414	15	0.936	8	12.3	33.88	1.372
A-4	8	0.3	0.75	263	12.54	425	28.75	0.792	3	13.4	37.82	1.179
A-Centre	7.9	0.4	0.9	188	12.54	436	13.75	0.934	4	15.31	31.49	1.372
B-1	8.1	0.4	0.9	388	24.19	425	26.25	1.036	4	11.42	31.6	1.604
B-2	8	0.6	0.75	250	23.29	425	23.75	1.324	3	18.9	15.14	1.575
B-3	8	0.5	0.9	225	14.33	436	18.75	0.934	4	18.33	26.64	1.112
B-4	7.8	0.4	0.9	313	27.77	470	31.25	1.456	6	18.42	29.11	1.623
B- Centre	8.1	0.4	0.9	400	26.88	515	25	1.739	3	19.3	19	1.247
C-1	8.1	0.5	0.9	250	18.81	436	21.25	2.036	3	13.9	22.04	1.44
C-2	8	0.5	0.9	313	34.04	448	26.25	2.31	5	17.5	24.59	1.556
C-3	7.8	0.3	0.9	263	17.92	436	23.75	1.072	3	18.71	22.2	1.198
C-4	8	0.5	0.9	250	25.98	481	26.25	1.739	6	17.45	22.37	0.938
C- Centre	7.9	0.4	0.9	263	14.33	448	23.75	1.342	4	19.7	21.46	1.285
Average	7.98	0.42	0.86	271.93	21.08	446.8	23.41	1.337	4.26	18.80	25.38	1.338

Table 3: Average values of each Sector

Soil Sample	pH	EC (dS/m)	OC (%)	N (Kg/Hec)	P (Kg/Hec)	K (Kg/Hec)	S (Kg/Hec)	Zn (ppm)	B (ppm)	Fe (ppm)	Mn (ppm)	Cu (ppm)
OFCFs												
A-Average	7.98	0.38	0.81	232.8	17.73	436.4	21	1.013	4.6	21.694	29.32	1.300
B-Average	8	0.46	0.87	315.2	23.29	454.2	25	1.297	4	17.274	24.29	1.432
C- Average	7.96	0.44	0.9	267.8	22.21	449.8	24.25	1.699	4.2	17.452	22.53	1.283
CFCFs												
A-Average	6.12	0.36	0.6	252.8	17.91	380.2	15.5	0.844	5	23.114	25.72	1.315
B-Average	6.66	0.4	0.39	245.4	12.89	342.4	13.75	0.618	5.8	23.778	22.59	1.048
C- Average	6.68	0.38	0.51	260.4	18.45	335.6	15.75	0.874	5.8	30.962	28.54	1.235
Recommended Range	6.5-7.5	≥1.0	0.5-7.5	280-560	12.5-25.0	135-335	≥10	≥0.6	≥0.5	≥4.5	≥3.5	≥0.2

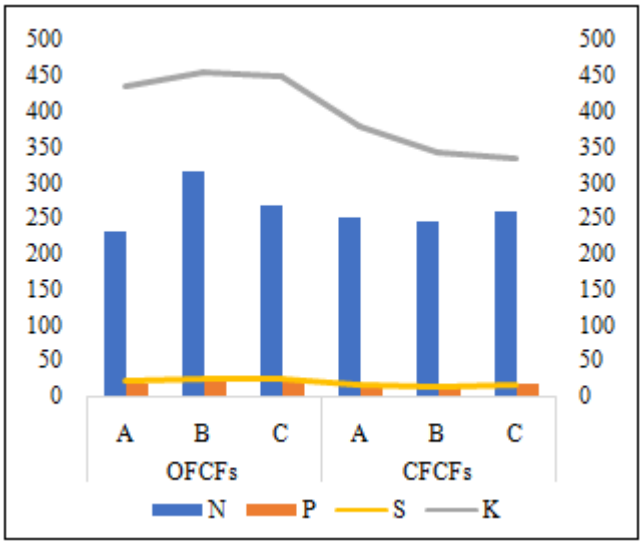

Figure 1: Average macronutrients values of each sector

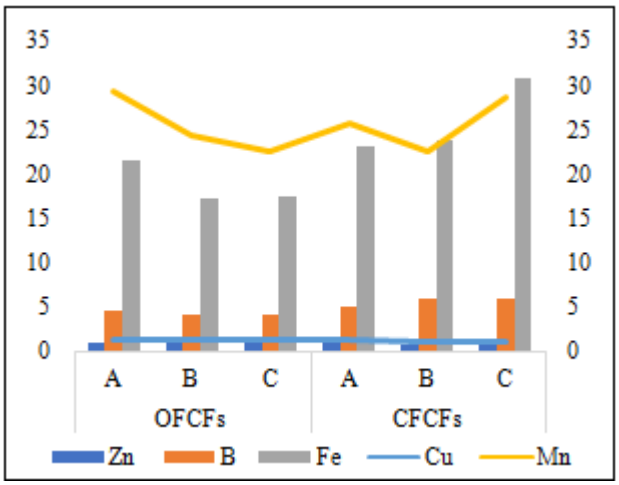

Figure 2: Average micronutrients values of each sector