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Assessment of Macro and Micro Nutrients in Soil and Yield Attributes of Maize (*Zea mays* L.)

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

The soil science central research farm at Sam Higginbottom University of Agriculture, Technology and Sciences located in Prayagraj carried the experiment on the field during the *Kharif* season of the year 2022. The soil of experimental field is sandy loam in texture. The plan involved using randomized block design to apply varying degrees of both large scale NPK supplements at concentrations ranging from (0%, 50% and 100%) as well as miniature Zn and Fe supplements also ranged from (0%, 50% and 100%). The significant results were found in T9 were organic carbon%, available nitrogen, available phosphorus, available potassium whereas we observed effective use of nutrient supplements growth and yield attributes are moderately in T_9 gave the best outcomes concerning plant height, no. of branches, no. of seeds, seed weight and yield. The study recommended using natural excrements alongside with full dose of NPK Additionally, utilizing both 100% large-scale and 100% miniature supplements together has the greatest impact on maize growth when compared to any other.

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1. INTRODUCTION

Maize (*Zea mays* L.) has been a significant oat crop inferable from its most noteworthy creation potential and flexibility to extensive variety of climate subsequently called as 'Sovereign of Cereals'. In India, maize is put in third place among the oats with regards to its significance, after rice and wheat ([1], and Suganya et al., 2020). In India, region, creation, and efficiency of maize is 9.76 mha, 26.14 mt and 26.80 kg ha^{-1} separately (Singh et al., 2017).

Among the cutting edge agro the board works on planting technique and compost application are basic for supporting the development and creation of maize particularly under downpour took care of condition. Impressive work has been accounted for on these viewpoints however endeavors are as yet expected to work on these strategies for getting greatest yield. Establishing a method plays an extraordinary part to play in expanding maize yield. Our ranchers for the most part utilize the old transmission strategy for planting that has such countless inconveniences, that is lopsided dispersion of seeds, profundity and seed lying dissipated being gotten by birds. Further developed establishing techniques might prompt expanded creation of maize which will bring about achieving independence in food and feed. The precipitation during kharif is fairly lacking for fruitful development of high yielding Maize cross breeds. Truth be told opportune accessibility of guaranteed water systems is one of the main considerations to plan the water system at 70% soil dampness accessibility all through the time of harvest development and improvement. In weighty soils a dampness level of 30% during the vegetable stage and 70% during the propagation and grain filling period is beneficial to enemys getting ideal yield three to five water systems are required during the kharif crop season (Singh et al., 2017).

1.1 Effect of NPK

Nitrogen in the board in maize creation framework is one of the principal worries since it is the most significant and essential supplement for development and improvement of the yield (Blumenthal et al*.,* 2008).

The fractional useful effectiveness of phosphorus for grain is higher at early development stages than at later stages since phosphorus is required for tillering and in light of the fact that the all-out phosphorus prerequisite is little comparative with nitrogen. Moreover, in the event that adequate phosphorus is retained at early development stages, it tends to be effectively reallocated to developing organs (Ray et al., 2011).

Potassium assumes a significant part in improving resistance of plants to dry season by expanding resilience of plants to dry spell by expanding movement and keeping up with water balance. Potassium is basically expected for plant development and required by plants in enormous amounts. Potassium can improve dry spell resilience in plants by moderating destructive impacts because of expanding movement and keeping up with water balance. Potassium plays a significant part in osmoregulation, photosynthesis, happening, stomata opening and shutting, and blend of protein. Photosynthetic rates, acclimatizes supply for seed and development rate are expansion in early planted crops than late planted (Rashid et al., 2010).

The communication coming about because of the impacts of N application assists with advancing plant development and it is feasible to track down sure associations between expanding levels of Zn and N composts [2]. Maize being a high supplement mining crop it needs a higher measure of NPK for its monetary creation. Zinc (Zn) and iron (Fe) lacks are legitimate general medical problems and a significant soil richness requirement to edit creation. By and large, there is a nearby topographical cross-over between soil lack and human lack of Zn and Fe demonstrating a high necessity for expanding groupings of micronutrients in food crops. Higher rice yield was recorded with consolidated soil utilization of $ZnSO_4$ and $FeSO_4$ each@25kg ha^{-1} and foliar shower of $ZnSO_4$ and $FeSO_4$ each@0.5%. A quick and reciprocal methodology is thus required for biofortification of food crops with Zn and Fe for the time being (Adhikari et al., 2021).

1.2 Effect of Zn, Fe

Zinc is one of the fundamental micronutrient components and is expected by crop plants in tiny sums. It assumes a huge part in different enzymatic and physiological exercises and carries out numerous synergist roles in plant framework other than change of starches,

chlorophyll, and protein blend (Singh et al., 2009). Zinc is a fundamental component for plants, creatures, and people. Its nutritive value is like those of non-leguminous vegetables like cauliflower, tomato, cucumber, and cabbage (Palai et al., 2017). Zinc component is fundamental for ordinary, sound development and generation of plants. The association coming about because of the impacts of N application assists with advancing plant development and it is feasible to track down collaborations between expanding levels of Zn and N manures [2]. Maize being a high supplement mining crop it needs a higher measure of NPK for its financial creation (Adhikari et al., 2021).

All India Facilitated Exploration Venture on Micronutrients depicted the dirt of India with respect to the lack of micronutrients. At present around 48.1 percent of Indian soils are lacking in diethylene-tri amine confined acetic acid derivation (DTPA) extractable zinc and 11.2 percent in iron. Zinc (Zn) and iron (Fe) lacks are proven and factual general medical problems and a significant soil richness requirement to trim creation. By and large, there is a nearby geological cross-over between soil lack and human lack of Zn and Fe demonstrating a high prerequisite for expanding convergences of micronutrients in food crops. Higher rice yield was recorded with joined soil utilization of $ZnSO_4$ and $FeSO_4$ each@25kg ha^{-1} and foliar splash of $ZnSO_4$ and $FeSO_4$ each@0.5%. A fast and reciprocal methodology is in this manner expected for biofortification of food crops with Zn and Fe for the time being.

2. MATERIALS AND METHODS

The procedures used and material which are used for driving the survey connecting with the flow point under field assessment are named "Assessment of Macro and Micronutrients in soil and Yield attributes of Maize (*Zea mays* L.)" The Prayagraj region is under the subtropical belt in South East Uttar Pradesh, experiencing crazy summer temperatures and brutal winters. The best close by temperature is 34 ℃ - 30 ℃ and is rarely basically as low as 21 ℃ - 25℃. The general dampness was between 20-94%. The base temperature during the creating season was 22.1 ℃ and the base was 37.84 ℃. Moisture least was 47.89 % and most limit was 95.89 %. The examination was driven at sandy dirt soil. The fundamental contained 9 treatments and the field was set in a Randomized Block Plan with three duplicates by taking large scale supplements (0%,50%,100%) and miniature supplements (0%,50%,100%) with different levels. Nitrogen, Phosphorus, Potassium and Zinc and Iron are applied basal does into the field. The wellsprings of NPK were urea, SSP, MOP, Zn as ZnSo4, Fe as $FeSo_4$.

3. RESULTS AND DISCUSSION

3.1 Response on Soil Physical Properties

Utilization of large scale and supplements change in mass thickness at 0-15 cm and 15-30 cm soil significance. Most noteworthy mass thickness was saved in by and large control into T1 for instance 1.365 Mg m^{-3}, 1.367 Mg m^{-3} and least mass thickness was recorded into (120:80:40 kg NPK+ 20: 15 Kg Zn: Fe) T_9 i.e.,1.352 Mg m^{-3}, 1.353 Mg m^{-3} at 0-15 cm and 15-30 cm soil significance independently. Most negligible particle thickness was recorded into T_9 i.e., 2.459 Mg $m^{-3}$and 2.460 Mg m^{-3} at 0-15 cm and 15-30 cm soil significance exclusively and most noteworthy particle thickness was saved in altogether control into T_1 for instance 2.465 Mg m^{-3} and 2.469 Mg m^{-3} at 0-15 cm and 15-30 cm soil significance independently. Near results were recorded by Bello et al*.,* (2019). The most raised pore space (%) of soil found at T_9 45.19, 45.08 and the unimportant effect (%) of pore space values found in T_1 44.98, 42.88 at 0-15 cm and 15-30 cm soil significance separately. Most outrageous Water holding limit was recorded into T_9 for instance 56.15, 52.78 percent and least water holding limit saved in out and out control into T_1 for instance 53.42, 48.98 percent at 0-15 cm and 15-30 cm soil significance separately. Equivalent result uncovered by Shehu et al*.,* (2019).

3.1.1 Response on soil chemical properties

Usage of full scale and Supplements impact the soil pH at 0-15 cm and 15-30 cm soil significance. Most noteworthy soil pH saw in through and through control for instance T_1 7.56 ,7.57 and least into (120:80:40 kg NPK+ 20: 15 Kg Zn: Fe) T_9 for instance 7.51, 7.52 at 0-15 cm and 15-30 cm soil significance person. Relative result was recorded by Reddy et al*.,* (2022). Most prominent electrical conductivity (dSm^{-1}) was seen in by and large control T_9 for instance 0.338, 0.336 dSm^{-1} and least in out and out control for instance T_1 0.319, 0.318 dSm^{-1} at 0-15 cm and 15-30 cm soil significance person. Relative results were recorded by Shahab et al*.,* (2016). Percent regular carbon most prominent

Table 1. Effect of macronutrients and micronutrients on physico-chemical properties of soil

Treatments	DEPTH	BD	PD	PS	WHC	PH	EC	OC	N	P	K	Zn	Fe
T_1	(0-15 cm)	1.365	2.465	44.98	53.42	7.56	0.319	0.534	232.68	22.57	116.52	0.49	4.3
	(15-30 cm)	1.367	2.469	42.88	48.98	7.57	0.318	0.532	227.00	18.25	114.35	0.47	4.0
T_2	(0-15 cm)	1.364	2.464	45.06	53.88	7.55	0.323	0.538	237.75	24.81	119.56	0.51	4.5
	(15-30 cm)	1.366	2.468	42.91	49.15	7.56	0.320	0.533	231.89	20.75	117.42	0.48	4.2
T_3	(0-15 cm)	1.363	2.463	45.09	54.65	7.56	0.326	0.542	239.83	28.72	120.26	0.53	4.7
	(15-30 cm)	1.365	2.467	42.93	49.89	7.58	0.322	0.535	233.67	22.57	118.32	0.50	4.4
T_4	(0-15 cm)	1.362	2.462	45.11	44.86	7.55	0.328	0.545	238.81	22.83	122.64	0.56	4.9
	(15-30 cm)	1.364	2.465	43.94	50.28	7.57	0.323	0.537	235.90	21.78	121.72	0.52	4.6
T_5	(0-15 cm)	1.360	2.461	45.12	55.19	7.52	0.330	0.548	242.87	27.52	124.67	0.57	5.2
	(15-30 cm)	1.363	2.464	43.95	50.89	7.56	0.324	0.539	237.12	25.46	123.23	0.54	4.8
T_6	(0-15 cm)	1.358	2.460	45.14	55.32	7.54	0.332	0.553	243.71	29.91	126.56	0.59	5.3
	(15-30 cm)	1.359	2.463	44.97	51.52	7.55	0.330	0.542	239.75	23.89	124.89	0.55	5.0
T_7	(0-15 cm)	1.356	2.459	45.16	55.79	7.53	0.335	0.558	240.48	23.77	127.89	0.61	5.5
	(15-30 cm)	1.357	2.462	44.99	52.19	7.54	0.334	0.547	239.90	20.65	125.46	0.58	5.1
T_8	(0-15 cm)	1.354	2.458	45.18	55.82	7.52	0.337	0.563	243.64	29.37	128.65	0.63	5.6
	(15-30 cm)	1.355	2.461	45.04	52.65	7.53	0.335	0.552	241.96	25.98	126.36	0.60	5.4
T_9	(0-15 cm)	1.352	2.459	45.19	56.15	7.51	0.338	0.569	245.99	31.62	129.45	0.65	5.7
	(15-30 cm)	1.353	2.460	45.08	52.78	7.52	0.336	0.561	243.89	28.89	127.76	0.62	5.5
F-test		NS	NS	S	S	NS	S	S	S	S	S	S	S
		NS	NS	S	S	NS	S	S	S	S	S	S	S
S. Em. (±)		-	-	0.001	0.011	-	0.001	0.001	0.853	0.067	0.008	0.005	0.091
		-	-	0.163	0.108	-	0.003	0.006	0.458	0.010	0.012	0.010	0.074
C.D. at 5%		-	-	0.034	0.033	-	0.004	0.003	0.255	0.064	0.025	0.014	0.273
		-	-	0.488	0.325	-	0.002	0.181	0.372	0.030	0.026	0.029	0.224

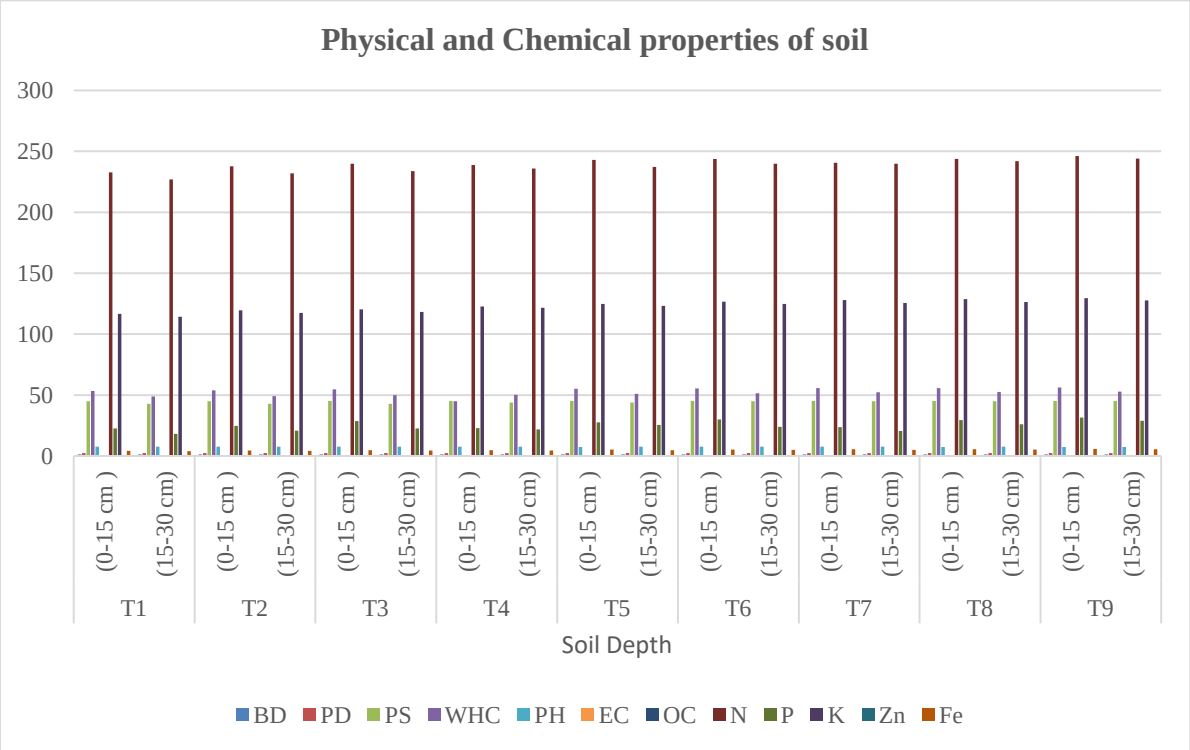

Fig. 1. Effect of macronutrients and micronutrients on physico-chemical properties of soil

viewed as in (120:80:40 kg NPK+ 20: 15 Kg Zn: Fe) T_9 for instance 0.569 %, 0.561 % in 0-15 cm and 15-30 cm soil profundities independently and least normal carbon were saved in through and through control for instance T_1 0.534, 0.532 % 0-15 cm and 15-30 cm soil profundities independently. Similar results were represented by Ali et al., [3]. Most noteworthy proportion of Nitrogen (kg ha-1) was kept in treatment T_9 i.e.,245.99 kg ha-1 and 243.89 kg ha^{-1} 0-15 cm and 15-30 cm soil significance separately. Least open nitrogen was kept in treatment T_1 i.e., 232.68 kg ha^{-1} and 227.00 kg ha^{-1} 0-15 cm and 15-30 cm soil significance independently. Relative result declared by Amanullah et al., [4]. Most outrageous open phosphorus was saved in treatment T_9 for instance 31.62 kg ha^{-1} and 28.89 kg ha^{-1} 0-15 cm and 15-30 cm soil significance exclusively and least available phosphorus was kept in treatment T_1 i.e., 22.57 kg ha-1 and 18.25 kg ha-1 0-15 cm and 15-30 cm soil significance independently. Equivalent result itemized by Das et al., 2016). Most outrageous Accessible potassium (kg ha^{-1}) in 0-15 cm and 15-30 cm soil significance for instance in 129.45 kg ha^{-1} and 127.76 kg ha^{-1} exclusively, least available potassium was kept in treatment T_1 i.e., 116.52 kg ha^{-1} and 114.35 kg ha^{-1} 0-15 cm and 15-30 cm soil significance independently. Tantamount result declared by Bojtor et al., [5-15]. Most outrageous Accessible Zinc (kg ha^{-1}) in 0-15 cm and 15-30 cm soil significance for instance in T_9 0.65 kg ha^{-1} and 0.62 kg ha^{-1} exclusively, least available Zinc was kept in treatment T_1 i.e., 0.49 kg ha^{-1} and 0.47 kg ha^{-1} 0-15 cm and 15-30 cm soil significance independently. Generally outrageous Accessible Iron (kg ha^{-1}) in 0-15 cm and 15-30 cm soil significance for instance in 5.7 kg ha^{-1} and 5.5 kg ha^{-1} exclusively, least open iron was kept in treatment T_1 i.e., 4.3 kg ha^{-1} and 4.0 kg ha^{-1} 0-15 cm and 15-30 cm soil significance independently**.** Practically identical result reported by Hafeez et al., [2].

4. CONCLUSION

Based on above finding, it is presumed that Suggested portion of manure of Nitrogen @ 120 kg ha^{-1}, Phosphorus @ 60 kg ha^{-1}, Potassium @ 40 kg ha^{-1} and Zinc @ 20 kg ha^{-1} and Iron @ 15 kg ha^{-1} in T_9(120:80:40 kg NPK + 20 : 15 Kg Zn : Fe) gave the best Physico-substance properties of soil, development, yield (37.78 q ha-1) and most elevated net benefit of ₹ 49,155 with money saving advantage proportion 1:2.44. It very well may be suggested for productive creation of

maize (*Zea mays* L.) Var. Moti and treatment is really great for soil physical and compound properties. Coordinated supplementing the executives is better for soil wellbeing and maize creation. As it is the consequence of only one year of study, further trial and error is expected for its suggestion which will assist in improving yielding per unit region for supporting efficiency and fruitfulness of soil.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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