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ORIGINAL ARTICLE **OPEN ACCESS**

Effect of NPK Levels and Micronutrients with and without Liquid Biofertilizers on Correlation (R) between Soil Health of Maize (*Zea mays* L.) Cv K-25

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Abstract
Available nutrient status and their correlation with the physico-chemical properties is an important indicator of soil health and plant nutrition. The research was conducted to understand the nutrient status in relation to soil properties in Prayagraj region of Prayagraj district of Utter Pradesh. Studied and determined the relationship between physico-chemical properties, available nutrients status of soil and yield of maize. Results indicated that the soil showed positive correlation with all the macro and micronutrients but significantly with available N and Zn and Mn and negatively significant with Mn. pH of soils showed no significant negative correlation with NPKS, Zn and Mn and significantly negative correlated with Mn. The soil organic carbon showed positive relationship with NPKS, Zn and Mn and significantly with K but negatively relationship with available P and Mn. Among physico-chemical soil properties, yield of maize showed positive relationship with organic carbon while positive and significant relationship with soil and negative relationship with pH and EC but negative and significant relationship with physiological parameters.

Keywords: Correlation, Physico-chemical properties, Nutrients, Yield, Maize *etc.*

Introduction

Maize is a significant cereal crop which possess third after wheat and rice on the planet. Maize is filled broadly in numerous nations of the world (Onasanya *et al.,* 2009). Maize which is naturally called has a place with the family Gramineae. Maize is one of the world's driving yields developed over a space of 139 million hectares with the creation of around 600 million tons of grain. USA drives the biggest region, trailed by Brazil, China, Mexico and India. It is filled in practically all provinces of India possessing a space of 6.3 million hectares with the creation and usefulness of 11.3 million tons and 1.9 million tons for each hectare separately (Kumar *et al.*, 2016). Maize grain contains around 70% Starch, 10% protein, 4% oil, 2.3% rough fiber, 10.4% albuminoides, 1.4% debris (Choudhary, 2014). Alongside this, it is plentiful in nutrient A, nutrient E, nicotinic corrosive, riboflavin and contains genuinely high phosphorus than rice and sorghum. Its grub and roughage contain 7-10% protein, 15-36% fiber, 2.09-2.62% ether separate, 0.42-0.70% calcium, 0.28-0.29% phosphorus, 0.45% magnesium, 1.34% potassium and 56% carb, thusly; it has exceptionally nutritive feed and feed. Other than food grain, feed and feed, it has prime significance in material, starch and huge enterprises (Rai, 2006). Maize is otherwise called "Sovereign of cereals" and sort of grain maize has been typically considered as helpless man's yield and involving the spot in the rich networks because of its diverse use as modern food and feed crops (Suke *et al.,* 2011). The better return possibility of maize can't be showed up to the edge because of a few biotic factors among which poor dietary administration is the excellent one. Being a comprehensive yield particularly the improved and cross breeds, react positive importance to applied supplements. Utilization of nitrogen up to 120 kg ha-1 was observed to be generally advantageous for grain and complete biomass creation of maize just as the money related returns (Maurya *et al.*, 2004). In current maize creation framework, improved plant to establish changeability frequently results from expanded contest among individual plants at dynamically higher

plant densities for restricting assets like N, occurrence photograph artificially dynamic radiation (IPAR), and soil dampness. Past examinations have regularly accentuated that stand consistency is fundamental for high usefulness levels, and that the expanded plant to (still up in the air and communicated utilizing an assortment of maize development and formative boundaries) decreases per unit region maize grain yields (GYA) through diminished pressure resilience. Subsequently, at higher plant populaces, assets accessibility should be sufficient to assist with keeping up with uniform development, advancement and grain yield of adjoining plants in a maize covering (Rao *et al.,* 2014). The idea of adjusted preparation makes ready for ideal plant supplement supply to acknowledge full yield capability of harvest. Not with standing, constant utilization of unevenness compost causes decrease in soil ripeness and yield decrease. Keeping these focuses in see, the current review was under produced to explore the results of adjusted treatment for better return of maize and soil ripeness (Paramasivan *et al.,* 2012). Compost assumes a significant part in expanding the maize yield and their commitment to economy is extremely high. Adjusted and ideal utilization of nitrogen, phosphorus and potassium just as sulfur compost assumes a crucial part in expanding the yields of grains.

Micronutrient assume a functioning part in the plant metabolic cycle beginning from cell improvement to breath, photosynthesis, chlorophyll arrangement, catalyst action, chemicals amalgamation, nitrogen obsession and so on the micronutrients will assume a significant defensive part in getting steadiness and supportability food creation. The job of large scale (NPK) and micronutrients (Zn and Mn) is essential in yields. Nitrogen is an essential constituent of proteins and in this way all catalysts (Raun and Johnson, 2013). P is engaged with practically all biochemical pathways as a part of energy transporter mixtures, ATP and ADP (Khalil, 2003). Six micronutrients i.e., Mn, Fe, Cu, Zn, B and Mo are known to be needed for all higher plants (Welch, 1995). These have been all around archived to be engaged with photosynthesis, N-obsession, breath and other biochemical pathways (Marschner and Romheld, 2011).

Fluid bio-manures are uncommon fluid definition containing not just the ideal valuable microorganisms and their organic discharges, yet additionally unique cell Protestants or substances that support the arrangement of torpid spores or sores for longer timeframe of realistic usability and resilience to unfavorable conditions. Bio-manures incorporate basically the nitrogen fixing, phosphate solubilizing and plant development advancing microorganisms. Biofertilizer is a characteristic info that can be applied as a supplement to, or as a substituent of compound compost in supportable agribusiness (Ebrahimpour *et al.,* 2011). Bio-manures helping the yield creation are Azotobacter, Azospirillum, blue green growth, Azolla, P-solubilizing microorganisms, mycorrhizae and rhizobium (Selvakumar *et al.,* 2009). Among the bio-manures, Azotobacter addresses the fundamental gathering of heterotrophic, non-cooperative, gram-negative, free-living nitrogen-fixing microbes. They are fit for fixing a normal 20 kg N/ha/year. The sort Azotobacter incorporates 6 species, with *A. chroococcum* most regularly occupying in different soils from one side of the planet to the other (Mahato *et al.,* 2009).

Materials and Methods

The present study entitled "Effect of NPK Levels and Micronutrients with and without Liquid Biofertilizers on Soil Health and Yield Attributes of Maize (*Zea Mays* L.) Cv. K-25"comprise of a field experiment which was carried out at the Soil Science & Agricultural Chemistry Research Farm, during Kharif season 2018 and 2019, which is located at 25024'30'' N latitude, 81051'10" E longitude and 98m above the mean sea level. The detail of the experimental site, soil and climate is described in this chapter together with the experimental design, layout plan, cultural practice and techniques employed for the parameters. The area of Prayagraj district comes under subtropical belt in the South East Uttar Pradesh, which experience extremely hot summer and fairly winter. The maximum temperature of the location reaches up to 460C-480C and seldom falls as 40C – 50C. The relative humidity ranged between 20 to 94 percent. The average rainfall in this area is around 1100mm annually. It comes under subtropical climate receiving the mean annual rainfall of about 1100mm, major rainfall from July to end of September. However, occasional precipitation was also not uncommon during winter. The winter months were cold while summer months were very hot and dry. The minimum temperature during the crop season was to be 27.10C and the maximum is to be 39.940C. The minimum humidity was 57.70% and maximum was to be 75.37%.

Results and discussion

Correlation between physical properties of soil

The correlation coefficient values of physical properties viz; Bulk density, Particle density,

% pore Space, Water Holding Capacity, soil pH, Organic carbon with available nutrient elements were worked out for two season pool data mean are presented in Table 1, 2, 3 and 4. The particle density content showed significant positive correlation with Particle density (0.128 @ CD P = 0.05) and % Pore space showed the significant positive correlation with particle density (0.937 @ CD P = 0.01). The water holding capacity showed the significant negative correlation with both particle density (-0.565 @ CD P = 0.01) and % Pore space (-1.00 @ CD P = 0.01). Water retaining capacity showed the significant positive correlation with bulk density (0.077 @ CD P = 0.05) and significant negative correlation with particle density (-0.565 @ CD P= 0.05). Similar type of results was observed in the Characterization and Classification of cotton growing soils in Amravati area of Guntur District, Andhra Pradesh by Jeje Naik P.

pH and EC

The pH showed the significant positive correlation with bulk density (0.109 @ CD P = 0.05) and % pore space (0.022 @ CD P = 0.05) as well as it showed the significant negative correlation with water holding capacity (-0.078 @ CD P = 0.05). The electrical conductivity showed the significant negative correlation with water holding capacity (-0.039 @ CD P = 0.05) and significant positive correlation with pH (0.028 @ CD P = 0.01). Similar types of results were observed in the Characterization and Classification of cotton growing soils in Amaravathi area of Guntur District, Andhra Pradesh by Jeje Naik P.

Available and total uptake of Nitrogen

The available nitrogen and total uptake of nitrogen showed the significant positive correlation with organic carbon (0.843 @ CD = 0.01). The available nitrogen and total uptake of nitrogen showed non- significant and negative correlation with EC (-0.279). Kumar et al., (2009) showed that relationship between available N content was a non – significant and negative correlation with EC in Dumka Lachimpur series in soils of Santhal Paraganas region of Jharkhand.

Available and total uptake of Phosphorus

The available and total uptake of Phosphorus showed the significant positive correlation with nitrogen (0.953 @ CD P = 0.01). The available and total uptake of Phosphorus showed the significant negative correlation with pH (-0.075 @ CD P = 0.05). Almost similar results were also reported by Waghmare et al. (2009) in the Ausa tahsil of Latur district, Meena et al. (2009) in some soil of Tonk District of Rajasthan, Singh (1988) in soils of Udaipur.

Available and total uptake of Potassium

The available and total uptake of Potassium showed the positive correlation with both nitrogen (0.976 @ CD P = 0.01) and Phosphorus (0.933 @ CD P = 0.01). The available and total uptake of potassium showed the significant negative correlation with EC (-0.178 @ CD P = 0.05). Higher K with more organic carbon might be due to creation of favorable soil environment with presence of high organic carbon matter and release of K from organic complexes in soil solution. Similar result were also reported by Paliwar (1996), Chuohan *et al.,* (2001), Meena *et al.,* (2006), Sharma *et al.,* (2008) and Waghmare *et al.,* (2009).

Available and total uptake of Sulphur

The available and total uptake of sulphur showed the positive correlation with both nitrogen (0.981 @ CD P = 0.01) and Potassium (0.970 @ CD P = 0.01). The available and total uptake of sulphur showed the significant negative correlation with EC (-0.314 @ CD P = 0.05). Similar result were also reported by Paliwar (1996), Chuohan *et al.,* (2001), Meena *et al.,* (2006), Sharma *et al.,* (2008) and Waghmare *et al.,* (2009).

Available and total uptake of Zinc

The available and total uptake of zinc showed the positive correlation with both sulphur (0.993 @ CD P = 0.01) and nitrogen (0.991 @ CD P = 0.01). The available and total uptake of zinc showed the significant negative correlation with EC (-0.307 @ CD P = 0.05). Similar result were also reported by Paliwar (1996), Chuohan *et al.,* (2001), Meena *et al.,* (2006), Sharma *et al.,* (2008) and Waghmare *et al.,* (2009).

Available and total uptake of Manganese

The available and total uptake of manganese showed the positive correlation with nitrogen (0.963 @ CD P = 0.01). The available and total uptake of manganese showed the significant negative correlation with EC (-0.240 @ CD P = 0.05). Similar result were also reported by Paliwar (1996), Chuohan *et al.,* (2001), Meena *et al.,* (2006), Sharma *et al.,* (2008) and Waghmare *et al.,* (2009).

Table 1: : Effect of NPK levels and micronutrients with and without liquid bio-fertilizers on Correlation between Physico – Chemical properties of Soil (pool data) of maize 2018 and 2019

	BD	**PD**	**%PS**	**WHC**	**pH**	**EC**	**OC**	**N**	**P**	**K**	**S**	**Zn**	**Mn**
BD	1												
PD	-.281*	1											
%PS	-.015	-.460**	1										
WHC	.077	-.565*	.937**	1									
pH	.109	-.023	.022	-.078	1								
EC	-.068	.128*	-.209	-.399	.280*	1							
OC	-.396	-.221	.784**	.733**	-.036	-.078	1						
N	-.091	-.493*	.964**	.961**	.013	-.279	.843**	1					
P	.015	-.496*	.965**	.971**	-.075	-.342*	.763**	.953**	1				
K	-.101	-.384	.970**	.917**	.072	-.178	.848**	.976**	.933**	1			
S	-.059	-.473*	.937**	.962**	.044	-.314	.829**	.981**	.944**	.970**	1		
Zn	-.023	-.500*	.959**	.970**	.063	-.307	.827**	.991**	.957**	.972**	.993**	1	
Mn	-.011	-.411	.951**	.889**	-.079	-.240	.726**	.895**	.963**	.892**	.851**	.882**	1

*** Correlation is significant at the 0.05 level.** **** Correlation is significant at the 0.01 level.**

Table 2: Effect of NPK levels and micronutrients with and without liquid bio-fertilizers on Correlation between Physico-Chemical Physiological parameters (pool data) of maize 2018 and 2019

	BD	PD	%PS	WHC	pH	EC	OC	N	P	K	S	Zn	Mn	P1	P2	P3	P4	P5	P6	P7	P 8
BD	1																				
PD	-.281	1																			
%PS	-.015	-.460*	1																		
WHC	.077	-.565*	.937**	1																	
P^H	.109	-.023	.022	-.078	1																
EC	-.068	.128	-.209	-.399	.280	1															
OC	-.396	-.221	.784**	.733**	-.036	-.078	1														
N	-.091	-.493*	.964**	.961**	.013	-.279	.843**	1													
P	.015	-.496*	.965**	.971**	-.075	-.342	.763**	.953**	1												
K	-.101	-.384	.970**	.917**	.072	-.178	.848**	.976**	.933**	1											
S	-.059	-.473*	.937**	.962**	.044	-.314	.829**	.981**	.944**	.970**	1										
Zn	-.023	-.500*	.959**	.970**	.063	-.307	.827**	.991**	.957**	.972**	.993**	1									
Mn	-.011	-.411	.951**	.889**	-.079	-.240	.726**	.895**	.963**	.892**	.851**	.882**	1								
P1	-.013	-.443	.970**	.967**	.051	-.295	.793**	.982**	.954**	.978**	.980**	.987**	.893**	1							
P2	-.002	-.463*	.988**	.958**	.014	-.299	.768**	.970**	.979**	.959**	.945**	.968**	.957**	.979**	1						
P3	.061	-.546*	.964**	.957**	-.083	-.296	.706**	.931**	.981**	.912**	.906**	.926**	.962**	.940**	.971	1					
P4	-.037	-.479*	.987**	.953**	.014	-.243	.790**	.966**	.979**	.952**	.938**	.961**	.958**	.969**	.994	.971	1				
P5	-.113	-.364	.980**	.901**	.083	-.181	.810**	.963**	.929**	.978**	.932**	.951**	.918**	.969**	.977	.915	.971	1			
P6	.021	-.564*	.930**	.967**	-.052	-.312	.759**	.928**	.973**	.886**	.922**	.938**	.915**	.928**	.947	.959	.966	.883	1		
P7	.006	-.577**	.963**	.977**	-.089	-.368	.737**	.960**	.983**	.920**	.937**	.953**	.937**	.950**	.971	.978	.971	.921	.965	1	
P8	-.029	-.487*	.989**	.917**	.041	-.202	.741**	.949**	.949**	.946**	.906**	.935**	.947**	.950**	.984	.957	.984	.977	.916	.955	1

* Correlation is significant at the 0.05 level. ** Correlation is significant at the 0.01 level.

P1: Plant height, P2:No. of leaves plant, P3:No. of cobs plant-1, P5: No. of grains cob-1row-1 , P6:Wt of grains rows cob-1 (gm), P7:No of rows/cob, P8-Seed weight (gm)

Table 3: Effect of NPK levels and micronutrients with and without liquid bio-fertilizers on Correlation between Physico-Chemical to nutrient uptake (pool data) of maize 2018 and 2019

	BD	PD	%PS	WHC	pH	EC	OC	N	P	K	S	Zn	Mn	U1	U2	U3	U4	U5
BD	1																	
PD	-.281	1																
%PS	-.015	-.460*	1															
WHC	.077	-.565*	.937**	1														
P^H	.109	-.023	.022	-.078	1													
EC	-.068	.128	-.209	-.399	.280	1												
OC	-.396	-.221	.784**	.733**	-.036	-.078	1											
N	-.091	-.493*	.964**	.961**	.013	-.279	.843**	1										
P	.015	-.496*	.965**	.971**	-.075	-.342	.763**	.953**	1									
K	-.101	-.384	.970**	.917**	.072	-.178	.848**	.976**	.933**	1								
S	-.059	-.473*	.937**	.962**	.044	-.314	.829**	.981**	.944**	.970**	1							
Zn	-.023	-.500*	.959**	.970**	.063	-.307	.827**	.991**	.957**	.972**	.993**	1						
Mn	-.011	-.411	.951**	.889**	-.079	-.240	.726**	.895**	.963**	.892**	.851**	.882**	1					
U1	-.009	-.524*	.934**	.953**	.054	-.323	.746**	.978**	.916**	.942**	.962**	.974**	.841**	1				
U2	.018	-.541*	.977**	.973**	-.040	-.332	.751**	.967**	.987**	.932**	.936**	.961**	.956**	.945**	1			
U3	.056	-.555*	.949**	.965**	-.095	-.372	.699**	.944**	.965**	.904**	.909**	.936**	.944**	.931**	.981**	1		
U4	-.053	-.468*	.959**	.970**	.022	-.313	.845**	.990**	.961**	.975**	.994**	.997**	.886**	.966**	.959**	.934**	1	
U5	-.007	-.538*	.974**	.979**	-.040	-.337	.780**	.975**	.989**	.946**	.959**	.975**	.940**	.946**	.993**	.967**	.974**	1

* Correlation is significant at the 0.05 level. ** Correlation is significant at the 0.01 level.

U1: Nitrogen Uptake, U2: Phosphorus Uptake, U3: Potassium Uptake, U4: Zinc Uptake, U5: Manganese Uptake

Table 4: Effect of NPK levels and micronutrients with and without liquid bio-fertilizers on Correlation between Physico-Chemical and yield parameters (pool data) of maize 2018 and 2019

	BD	PD	%PS	WHC	pH	EC	OC	N	P	K	S	Zn	Mn	Y1	Y2	Y3	Y4
BD	1																
PD	-.281	1															
%PS	-.015	-.460*	1														
WHC	.077	-.565*	.937**	1													
pH	.109	-.023	.022	-.078	1												
EC	-.068	.128	-.209	-.399	.280	1											
OC	-.396	-.221	.784**	.733**	-.036	-.078	1										
N	-.091	-.493*	.964**	.961**	.013	-.279	.843**	1									
P	.015	-.496*	.965**	.971**	-.075	-.342	.763**	.953**	1								
K	-.101	-.384	.970**	.917**	.072	-.178	.848**	.976**	.933**	1							
S	-.059	-.473*	.937**	.962**	.044	-.314	.829**	.981**	.944**	.970**	1						
Zn	-.023	-.500*	.959**	.970**	.063	-.307	.827**	.991**	.957**	.972**	.993**	1					
Mn	-.011	-.411	.951**	.889**	-.079	-.240	.726**	.895**	.963**	.892**	.851**	.882**	1				
Y1	-.072	-.494*	.932**	.965**	.003	-.353	.813**	.989**	.935**	.959**	.987**	.989**	.848**	1			
Y2	.005	-.579**	.923**	.993**	-.070	-.394	.765**	.972**	.956**	.921**	.973**	.975**	.861**	.979**	1		
Y3	-.020	-.555*	.930**	.988**	-.047	-.383	.783**	.982**	.954**	.937**	.982**	.984**	.860**	.990**	.998**	1	
Y4	.036	-.576**	.915**	.981**	-.019	-.395	.736**	.968**	.933**	.922**	.974**	.976**	.835**	.986**	.989**	.992**	1

* Correlation is significant at the 0.05 level. ** Correlation is significant at the 0.01 level.

Y1: Grain yield, Y2: Stover yield, Y3: Biological yield, Y4: Harvest index

Note :- BD-Bulk Density, PD-Particle Density, %PS-Percent Pore Space, WHC- Water Holding Capacity, PH- Power of Hydrogen, EC- Electrical Conductivity, OC-Organic Carbon , N-Nitrogen, P-Phosphorus, K- Potassium, S-Sulphur, Zn-Zinc, Mn- Manganese.

Conclusion

The taxonomic critical understanding challenges in the 21st century conservation of phytososiological study on Kushmi forest medicinal species. The fundamental importance of the biodiversity and constituents used in preparation a range of medicinal properties through scientific analysis. The research gives a general overview of the woody and non-woody plant species currently present in the forest. In this study a total 142 plant species with highest tree species (83) followed by shrub species (29) and minimum of herb species (27) recorded in the study area. In order to preserve the sustainable usage of the region's phytososiological development, forest resources are crucial for the local and regional population today and in the future. The habitat and cultural significance of these forest species can also be provided via forest products.

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