International Journal of Multidisciplinary Research and Development
Online ISSN: 2349-4182, Print ISSN: 2349-5979, Impact Factor: RJIF 5.72
www.allsubjectjournal.com
Volume 3; Issue 8; August 2016; Page No. 29-32

Effect of different levels of chemical fertilizers on soil physico-chemical properties of inceptisols

Sulaiman Azizi, Dr. Tarence Thomas, Smriti Rao

Department of Soil Science Sam Higginbottom Institute of Agriculture, Technology& Sciences (Formerly-Allahabad Agricultural Institute) (Deemed-To-Be-University) Allahabad 211007 (U.P.), India

Abstract
A field experiment was conducted during December, 2015 – March, 2016 kharif season. It carried out at the research farm of Department of Soil Science, Sam Higginbottom Institute of Agriculture, Technology and Sciences, (Deemed–to-be-University) Allahabad, India and studied the Effect of different Levels of Chemical Fertilizers on Soil Health and Yield of Maize (*Zea mays* L.*)*. The experiment was laid out (RBD) Sample Randomize Block Design with three replication and fertilizers are used in different levels. Nitrogen (120, 90,50,0 kg/ha), phosphorus (60, 45,30,0 kg/ha), potassium (40, 30, 20, 0) are applied under sandy loam soil. The result shows that application Inorganic fertilizers increased soil chemical properties but some parameters of soil physical properties decreased. It was recorded from the application of chemical fertilizers in treatment T_1 (120kg N ha^{-1}, 60 kg P ha^{-1}, 20kg K ha^{-1}) improved nitrogen. Available phosphorus was found more in T_5(60kg N $ha^{-1,}$ 60kg P ha^{-1}, 20kg K ha^{-1}), followed by T_2 (90kg N $ha^{-1,}$ 45kg P ha^{-1}). The physical and chemical parameters of soil such as bulk density and particle density increased however pores space, EC decreased.

Keywords: Inorganic fertilizers, soil physical properties, chemical properties

1. Introduction
Intensive land use with continuous use of higher doses of inorganic fertilizers significantly influences soil health and crop growth. This has raised concerns about the potential longterm adverse effects on soil health and environmental quality (Sarkar and Singh 1997). Marked deterioration in soil physical conditions resulting from continuous application of nitrogen (N), phosphorus (P), and potassium (K) fertilizers was reported (Parameswar *et al.*, 1989). Maize is one of the popular cereal crops grown throughout the globe. Being an exhaustive crop, maize requires high quantity of N for its optimum growth. Moreover in India, the higher subsidy rates on nitrogenous fertilizers artificially reduced their cost compared to P and K fertilizers. This encourages the farmers to use nitrogenous fertilizers in abundance ignoring their long-term effects on soil quality. (Sarma, *et al.*, 2015) [6].

2. Materials and Methods
The experiment was conducted at the research farm of Department of Soil Science, Sam Higginbottom Institute of Agriculture, Technology and Sciences, (Deemed–to-be-University) Allahabad during Rabi season. The experiment was laid out in Randomized Block Design. The treatments have been replicated three times. The different treatments were employed randomly in each replication. The experiment area is located on the south of Allahabad on the right site of Yamuna River on the road at a distance of about 6 km from Allahabad city. It is situated at $25^0 57$ N latitude, $81^0 59$ E longitudes and the altitude of 98 meter above the near sea level. And fertilizers used in different levels. Nitrogen (120, 90, 50, 0) kg ha^{-1}, phosphorus (60, 45, 30, 0) kg ha^{-1}, potassium (40, 30, 20, 0) kg ha^{-1} were applied under sandy loam soil.

Fertilizers were applied according to treatment combination. Amount of phosphorus was calculated on the basis general recommendation for maize crop (60 kg ha^{-1} P_2O_5). SSP was supplied as the source of phosphorus and used difference doses in different plots. First phosphorus application calculated in 1ha and then in $1m^2$. The application of potassium were applied 20, 30, 40 kg ha^{-1} and required amount of K_2o (MOP 60%) needed for different treatment were calculated and was suppilied as basal dose. Urea (46% Nitrogen) was applied as source of nitrogen 30 days after sowing, 60 days and 90 days by furrow replacement method at distance of 10 cm from the crop rows.

After crop harvest soil sample were taken from each plot for determination of important physical Bulk density (g cm^{-3}) particle density (g cm-3) Pore space (%) Water holding capacity (%) Soil moisture content (%) by (Muthuvel *et al.*, 1999) and chemical properties of soil. The soil pH determined in 1:2 soil water suspensions with the help of systronic digital electric pH meter (Jackson 1958). Using electrical conductivity meter Digital EC meter (Wilcox, 1950) [13]. Organic carbon was estimated by wet digestion method of Walkley and Black (1947) [12]. Available nitrogen was determined by using alkaline potassium permanganate method as given by Subbaih and Asija (1956) [14]. Available phosphorus is determined with the help of Olsen colorimetric method (1954). Available phosphorus is determined with the help of Toth and Prince Method (1949).

3. Result and discussion
Physical properties
Bulk density (g cm^{-3})
The result of the data depicted that the maximum bulk density was found in T_1 (120 kg N ha^{-1}, 60 kg P ha^{-1}, 20 kg K ha^{-1}) (1.60), followed by T_4 (120 kg N $ha^{-1,}$ 45 kg P $ha^{-1,}$ 30 kg K ha^{-1}) (1.51) and minimum bulk density recorded (1.27) in T_0 (control).

Table 4.7 depicted that the mean value of bulk density of soil (Mgm^{-3}) was found non-significant different. It was also observed the bulk density of soil was gradually increased with an increase in dose of NPK. The effect of NPK on bulk density of soil was also found significantly. Because the presence of NPK in optimum amount increase bulk density of soil. It's contains higher amount of salt, silt and clay particle. As these indicated an enrichment of fine fractions ie. Silt and clay a part from the retention of dissolved O.M. leading to change in physical properties of soil by Awad *et al*. (2014) [2].

Particle density (g cm^{-3})

The result of the data depicted that the maximum particle densitywas found in T_1 (120kg N ha^{-1}, 60 kg P ha^{-1}, 20 kg K ha^{-1}) (5.25), followed by T_7 (120 kg N ha^{-1}, 30 kg P ha$^{-1,}$ 40 kg K ha^{-1}) (5.17) and minimum particle density recorded (2.81) in T_0 (control).

Table 4.8 depicted that the mean value of particle density of soil (Mgm^{-3}) was found significant different. It was also observed the particle density of soil was gradually increased with an increase in dose of NPK. The effect of NPK on particle density of soil was also found significantly. Because the presence of NPK in optimum amount increase particle density of soil. It's contains higher amount of salt, silt and clay particle. As these indicated an enrichment of fine fractions i.e. Silt and clay a part from the retention of dissolved O.M. leading to change in physical properties of soil by Awad *et al.* (2014) [2].

Pore space (%)

The result of the data depicted that the maximum pore space was found in T_8 (60 kg N ha^{-1}, 60 kg P ha^{-1}, 40 kg K ha^{-1}) (64.70), followed by T_4 (120 kg N ha$^{-1,}$ 45 kg P ha$^{-1,}$ 30 kg K ha^{-1}) (63.14) and minimum pore spacer corded (55.41) in T_0 (control).

Bulk density and pore space was recorded maximum in INM practice including vermicompost and recommended dose of NPK. Kannan *et al*. (2013) [3].

Water holding capacity (%)

The result of the data depicted that the maximum Water holding capacity was found in T_1(120 kg N ha^{-1}, 60 kg P ha^{-1}, 20 kg K ha^{-1}) (23.78), followed by T_4 (120 kg N ha$^{-1,}$ 45 kg P ha$^{-1,}$ 30 kg K ha^{-1}) (23.53%) and minimum Water holding capacity recorded (18.22%) in T_0 (control).

Table 4.10 depicted that the mean value of Water holding capacity of soil was found significant different. It was also observed the pore space of soil was gradually increased with an increase in dose of NPK. The effect of NPK on Water holding capacity of soil was also found significantly. Because the presence of NPK in optimum amount increase Water holding capacity of soil. It's contains higher amount of salt, silt and clay particle. As these indicated an enrichment of fine fractions i.e. Silt and clay a part from the retention of dissolved O.M. leading to change in physical properties of soil similar findings had also been reported Singh (2003).

Soil moisture content (%)

The result of the data depicted that the maximum soil moisture contentwas found in T_6(90 kg N ha^{-1}, 30 kg P ha^{-1}, 40 kg K ha^{-1}) (12.37), followed by T_0 (0 kg N ha^{-1}, 0 kg P ha^{-1}, 0 kg K ha^{-1}) (23.53%) and minimum soil moisture content recorded (6.11%) in T_4(120 kg N ha$^{-1,}$ 45 kg P ha$^{-1,}$ 30 kg K ha^{-1}).

Table 4.11 depicted that the mean value of soil moisture content was found significant different. It was also observed the pore space of soil was gradually increased with an increase in dose of NPK. The effect of NPK on soil moisture content of soil was also found significantly. Because the presence of NPK in optimum amount increase soil moisture content. It's contains higher amount of salt, silt and clay particle. As these indicated an enrichment of fine fractions i.e. Silt and clay a part from the retention of dissolved O.M. leading to change in physical properties of soil Similar findings had also been reported Singh (2003).

Table 1: Effect of different levels of chemical fertilizers on soil physical properties

Treatments		Bulk density (Mgm^{-3})	Particle density (g/cm^3)	Pore space of soil	Water holding capacity (%)	Soil moisture content (%)
T_0	0 kg N ha^{-1}, 0 kg P ha^{-1}, 0 kg K ha^{-1}	1.27	2.81	55.41	18.22	11.70
T_1	120 kg N ha^{-1}, 60 kg P ha^{-1}, 20 kg K ha^{-1}	1.6	3.25	57.59	20.29	8.84
T_2	90 kg N ha$^{-1,}$ 45 kg P ha^{-1}, 30 kg K ha^{-1}	1.44	2.55	57.04	23.78	8.85
T_3	60 kg N ha^{-1}, 30 kg P ha^{-1}, 30 kg K ha^{-1}	1.28	2.17	58.52	18.74	9.71
T_4	120 kg N ha$^{-1,}$ 45 kg P ha$^{-1,}$ 30 kg K ha^{-1}	1.51	2.6	63.14	23.53	6.11
T_5	60 kg N ha$^{-1,}$ 60 kg P ha^{-1}, 20 kg K ha^{-1}	1.34	3.48	62.88	16.37	9.18
T_6	90 kg N ha^{-1}, 30 kg P ha^{-1}, 40 kg K ha^{-1}	1.4	3.62	61.11	18.70	12.37
T_7	120 kg N ha^{-1}, 30 kg P ha$^{-1,}$ 40 kg K ha^{-1}	1.39	3.17	62.11	14.55	6.58
T_8	60 kg N ha^{-1}, 60 kg P ha^{-1}, 40 kg K ha^{-1}	1.4	3.48	64.7	22.79	7.70
	F- test	S	S	NS	S	S
	S. Ed. (±)	0.088	0.26	5.105	2.809	1.830
	C. D. (P = 0.05)	0.181	0.57	10.537	5.798	3.777

Chemical properties

Available nitrogen (kg ha^{-1})

The result of the data depicted that the maximum Available nitrogen was found in T_1(120 kg N ha^{-1}, 60 kg P ha^{-1}, 20 kg K ha^{-1}) (277.67), followed by T_4 (120 kg N ha$^{-1,}$ 45 kg P ha$^{-1,}$ 30 kg K ha^{-1}) (276.00) and minimum Available nitrogen recorded (238.00) in T_0 (control).

Table 4.12 depicted that the mean value of Available nitrogen was found significant different. It was also observed maximum nutrient use efficiency(NUE) was obtained from the field where recommended dose of NPK fertilizer (90-60-40 kg ha-1) was added, that was 77 and 65 kg maize fodder/kg nutrient in the years 2003 and 2004, respectively The effect of hardpan and and NPk fertilizers on nitrogen, phosphorous and potassium concentration was significant during the year 2003 while during the year 2004 this effect on nitrogen concentration in maize plants was non-significant while on phosphorus and potassium concentration was significant Raza *et al.* (2005) [4].

Available phosphorus (kg ha^{-1})

The result of the data depicted that the maximum available phosphorus was found in T_5(60 kg N ha$^{-1,}$ 60 kg P ha^{-1}, 20 kg K ha^{-1}) (27.19), followed by T_2 (90 kg N ha$^{-1,}$ 45 kg P ha^{-1}, 30 kg K ha^{-1}) (26.12) and minimum Available nitrogen recorded (15.29) in T_0 (control).

Table 4.13 depicted that the mean value of Available phosphorus was found non-significant different. It was also observed maximum nutrient use efficiency (NUE) was obtained from the field where recommended dose of NPK fertilizer (90-60-40 kg ha-1) was added, that was 77 and 65 kg maize fodder/kg nutrient in the years 2003 and 2004, respectively The effect of hardpan and NPk fertilizers on nitrogen, phosphorous and potassium concentration was significant Raza *et al. (*2005) [4].

Available potassium (kg ha^{-1})

The result of the data depicted that the maximum Available potassium was found in T_7 (120 kg N ha^{-1}, 30 kg P ha$^{-1,}$ 40 kg K ha^{-1}) (165.00), followed by T_8 (60 kg N ha^{-1}, 60 kg P ha^{-1}, 40 kg K ha^{-1}) (164.67) and minimum Available potassium recorded (127.67) in T_0 (control).

Table 4.14 depicted that the mean value of Available potassium was found significant different. Similarly, the maximum total P and K uptake (73.82 and 206.50 kg / ha, respectively) was observed from the enhanced levels of P and K application (200-95-88-7.4 and 200-76-110-7.4 kg N-P-K-Zn / ha. The trend of available N, P, K and Zn were also same as to that of uptake pattern due to the enhanced levels of nutrients at post-harvest soil. Paramasivan *et al* (2012) [5].

Organic carbon (%)

The result of the data depicted that the maximum Organic carbon (%)was found in T_6(90 kg N ha^{-1}, 30 kg P ha^{-1}, 40 kg K ha^{-1}) (0.42), followed by T_1 (120 kg N ha^{-1}, 60 kg P ha^{-1}, 20 kg K ha^{-1}) (0.40) and minimum Organic carbon (%)recorded (0.33) in T_0 (control).

Table 4.15 depicted that the mean value of Organic carbon (%) of soil was found non-significant of different level of NPK. It was also observed the organic carbon of soil were gradually increase with an increase in dose of NPK. Selvi *et al*. (2002) [8]. N fertilization rate (7280 kg ha-1) in maize-dhaincha cropping sequence successfully maintains the SOC balance and optimize N stock in soil. Recorded high crop yield, profuse root biomass and SOC stock with increasing N fertilization. Sarma *et al* (2015) [6].

PH (1:2) w/v

The result of the data depicted that the maximum pH was found in T_1 (120 kg N ha^{-1}, 60 kg P ha^{-1}, 20 kg K ha^{-1}) (7.20), followed by T_7 (120 kg N ha^{-1}, 30 kg P ha$^{-1,}$ 40 kg K ha^{-1}) (7.19) and minimum pH recorded (6.40) in T_0 (control).

Application of nitrogen (N) fertilizer is one of the most important approaches on improving soil physical-chemical characters and maize grain yield using hybrid variety Zhengdan 958 in 2011 and 2012. Results indicated that the soil bulk densities of T2 (CK) and T1 were the lowest compared to other treatments in 2011 and 2012, respectively, whereas the soil bulk density of T5 in 2011 and T3 in 2012 were higher than other treatments. The soil porosity and field capacity of T5 in 2011 and T3 in 2012 were lower than other treatments, but those of CK in 2011 and T1 in2012 were higher than other treatments. The pH values of T3 to T7 were lower than other treatments. These results indicated that the soil bulk densities were increased, whereas the soil porosity, field capacity and values pH were decreased by N application at different stages. N application could increase the N contents of leaf and stem Heng *et al. (*2014) [7].

EC (dSm^{-1})

The result of the data depicted that the maximum EC was found in T_1 (120 kg N ha^{-1}, 60 kg P ha^{-1}, 20 kg K ha^{-1}) (0.31), followed by T_4 (120 kg N ha$^{-1,}$ 45kg P ha$^{-1,}$ 30 kg K ha^{-1}) (0.29) and minimum EC recorded (0.17) in T_0 (control).

Table 4.17 depicted that the mean value of EC (dSm^{-1}) of soil was found significant of different levels of NPK. It was also observed the EC of soil were gradually increased with an increase dose of NPK. The interaction effect NPK on EC of soil was also found significantly. Because NPK contain amount of salt and other nutrients. As salt promotes salinity in soil, so it brings increase in EC. The increase might be attributed to the addition of salts through application of increase dose of inorganic fertilizer. It brings significant increase EC of soil. Selvi *et al*. (2002) [8].

Table 4.2: Effect of different level treatment combinations of chemical fertilizers on soil chemical properties

Treatments		Available nitrogen (kg ha^{-1})	Available phosphorus (kg ha^{-1})	Available potassium (kg ha^{-1})	Organic carbon (%)	pH(1:2) w/v	EC (dSm^{-1})
T_0	0 kg N ha^{-1}, 0 kg P ha^{-1}, 0 kg K ha^{-1}	238.00	15.29	127.67	0.34	6.40	0.17
T_1	120 kg N ha^{-1}, 60 kg P ha^{-1}, 20 kg K ha^{-1}	277.67	26.08	140.33	0.42	7.20	0.31
T_2	90 kg N ha$^{-1,}$ 45 kg P ha^{-1}, 30 kg K ha^{-1}	240.83	26.12	143.33	0.37	6.85	0.24
T_3	60 kg N ha^{-1}, 30 kg P ha^{-1}, 30 kg K ha^{-1}	261.33	18.00	147.67	0.42	6.73	0.23
T_4	120 kg N ha$^{-1,}$ 45 kg P ha$^{-1,}$ 30 kg K ha^{-1}	276.00	20.17	156.33	0.38	7.00	0.29
T_5	60 kg N ha$^{-1,}$ 60 kg P ha^{-1}, 20 kg K ha^{-1}	244.33	27.19	140.33	0.37	7.10	0.23
T_6	90 kg N ha^{-1}, 30 kg P ha^{-1}, 40 kg K ha^{-1}	250.11	21.45	164.67	0.42	6.62	0.18
T_7	120 kg N ha^{-1}, 30 kg P ha$^{-1,}$ 40 kg K ha^{-1}	242.44	23.50	165.00	0.43	7.19	0.20
T_8	60 kg N ha^{-1}, 60 kg P ha^{-1}, 40 kg K ha^{-1}	244.59	20.83	164.67	0.39	7.02	0.16
	F- test	S	S	S	NS	NS	NS
	S. Ed. (±)	8.116	1.902	5.663	0.06	0.268	0.073
	C. D. (P = 0.05)	16.751	3.926	11.689	0.12	0.553	0.151

4. Conclusion

Thus it can be concluded that different level of chemical fertilizer improved soil available nutrient, increased soil available nitrogen, phosphorus, potassium and electrical conductivity. However P^H of soil decreased and also among the treatments T1 recorded the best treatments which increased the availability of nutrient and influenced on physical properties of soil as well.

5. References

1. Shamim Gul, Khan MH, Khanday B A, Nabi S. Effect of Sowing Methods and NPK Levels on Growth and Yield of Rainfed Maize (Zea mays L.). Hindawi Publishing Corporation Scientifica 2015, 1-6.
2. Awad M, Sulaimani Samir G, Al El-Nakhlawy Fathy S. effect of integrated use of organic and inorganic fertilizers on NPK uptake Efficiency By maize (zea mays L), International journal of Applied research and studies (IJARS) 2014; 3(7). ISSN: 2278-9480
3. Kannan RL, Dhivya M, Abinaya D, Krishna RL, Krishnakumar S. Effect of Integrated Nutrient Management on Soil Fertility and Productivity in Maize. Bulletin of Environment, Pharmacology and Life Sciences. 2013; 2(8):61-67.
4. Raza W, YOUSAF S, NIAZ A, RASHEED MK, HUSSAIN I. subsoil compaction effects on soil properties, nutrient uptake and yield of maize fodder (zea mays l.) Pak. J Bot., 2005; 37(2):933-940, 71-74.
5. Paramasivan M, Malarvizhi P, Thiyageswari S. Balanced use of inorganic fertilizers on maize (Zea mays) yield, nutrient uptake and soil fertility in alfisols. Karnataka J Agric. Sci., 2012; 25(4):423-426.
6. Sarma B, Bhattacharya SS, Gogoi N, Paul S, Baroowa B. Impact of N Fertilization on C Balance and Soil Quality in Maize-Dhaincha Cropping Sequence. Journal of Agricultural Sciences. 2015; 60(2):135-148.
7. Heng H. Effects of Different Nitrogen Applications on Soil Physical, Chemical Properties and Yield in Maize (Zea mays L.). Agricultural Sciences, 2014; 5:1440-1447.
8. Selvi D, Santhy P, Dhakshinamoorthy M. Effect of continuous application of organic and inorganic fertilizers on micronutrient status of an inceptisol. Agropedology, 2002; 12:148-156.
9. Jackson ML. soil chemical analysis. Prentice Hall of India. Private Ltd., New Delhi, 1967.
10. Muthuvel P, Udayasoorian C, Natesan R, Ramaswami PP. Introduction to Soil Analysis, Tamil Nadu Agricultural University Coimbatore-641002, 1992.
11. Toth SJ, Prince AL. Estimation of cation exchange capacity and exchangeable Ca, K and Na content of soil by flame photometer technique. Soil sci., 1949; 67:439-445.
12. Walkley A, Black IA. critical examination of rapid method for determining organic carbon in soils, effect of variation in digestion conditions and inorganic soil constituent, soil sci 1947; 632:251.
13. Willcox Lv. Electrical conductivity, Am. water works Assoc., 1950; 42:775-776.
14. Subbiah BV, Asija CL. A rapid procedure for the Estimation of Available synthetic fertilizer influences crop yields, soil properties, nitrate leaching and crop nutrient content, Compost Sci. Utilization 1956; 17(2):117-126.
15. Jaiswal PC. Soil, Plant and Water Analysis. At Process World India c-90 sec-63 Noida, 2003, 1-123.