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Effect of different level of Fertilizers and Neem cake on physico-chemical properties in soil of Allahabad district of Uttar Pradesh, India

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Abstract
The field experiment was carried out at soil science crop research farm of Sam Higginbottom institute of Agriculture, Technology and Sciences (deemed to be university) Allahabad, during Rabi season in the year 2015-2016. The result was carried out the treatment T_8-[NPK 100% RDF + Neem cake 100 kg/ha] found to be significantly superior over than other treatments for as soil amendment and soil quality improvement. Observed that, the application of Nitrogen with Neem cake were excellent source to fertilization than fertilizers only in soil.

Keywords: Amendment, Soil Quality, fertilization, Neem cake, photosynthate, soil temperature, drought, enzymes, Days After Sowing (DAS), Augur

1. Introduction

Potato (*Solaneum tubrosum* L.) is one of the major food crops in the mid and high altitude areas of Ethiopia. It is recognized as famine relief crop at the end of the rainy season when cereal crops are not ready for harvest, especially in the highland areas, where cereals mature after an extended period. Potato is grown in diverse soil types from black heavy soils (vertisols) to red soils (nitosols) in the central highlands of Ethiopia. Potatoes are annually grown on an area of about 160,000 hectares (World Potato Atlas, 2007).

Potato is one of the leading commercial crops of Kashmir valley and is cultivated on an area of about 2500 ha with the production and productivity of 32.5 thousand t and 13 t/ha, respectively (Anonymous, 2009).

The climate and soil of Bihar are quite suitable for potato cultivation. In the Indo-Gangetic plains of Bihar, potato based cropping systems play an important role in improving the productivity of the region due to the fact that potato produces almost 2-3 times more dry matter and edible energy per unit area and time than cereal crops like wheat and rice (Sharma *et al.*, 2004).

The nitrogen (N) is a vital nutrient for the activity of plant organs. It is a fraction of many components such as; amino acids, nucleic acids, chlorophyll and etc. Thus, plant growth can be affected by the amount of nitrogen (Najm *et al.*, 2012).

Nitrogen fertilisation was reported to increase the average fresh tuber, plant height, leaf number and tuber, weight per plant responded positively application and Leaf area increased (Kandil *et al.*, 2011).

Being a heavy feeder of nutrients, potato requires high amount of nitrogen, phosphorus and potassium. Chemical fertilizers are the main source of nutrients used for potato cropping. However, continuous dependence on chemical fertilizers causes nutritional imbalance and adverse effects on physico-chemical and biological properties of the soil. Integrated nutrient management (INM) is a better approach for supplying nutrition or food to the crop by including organic and inorganic sources of nutrients (Arora, 2008).

2. Materials and Methods

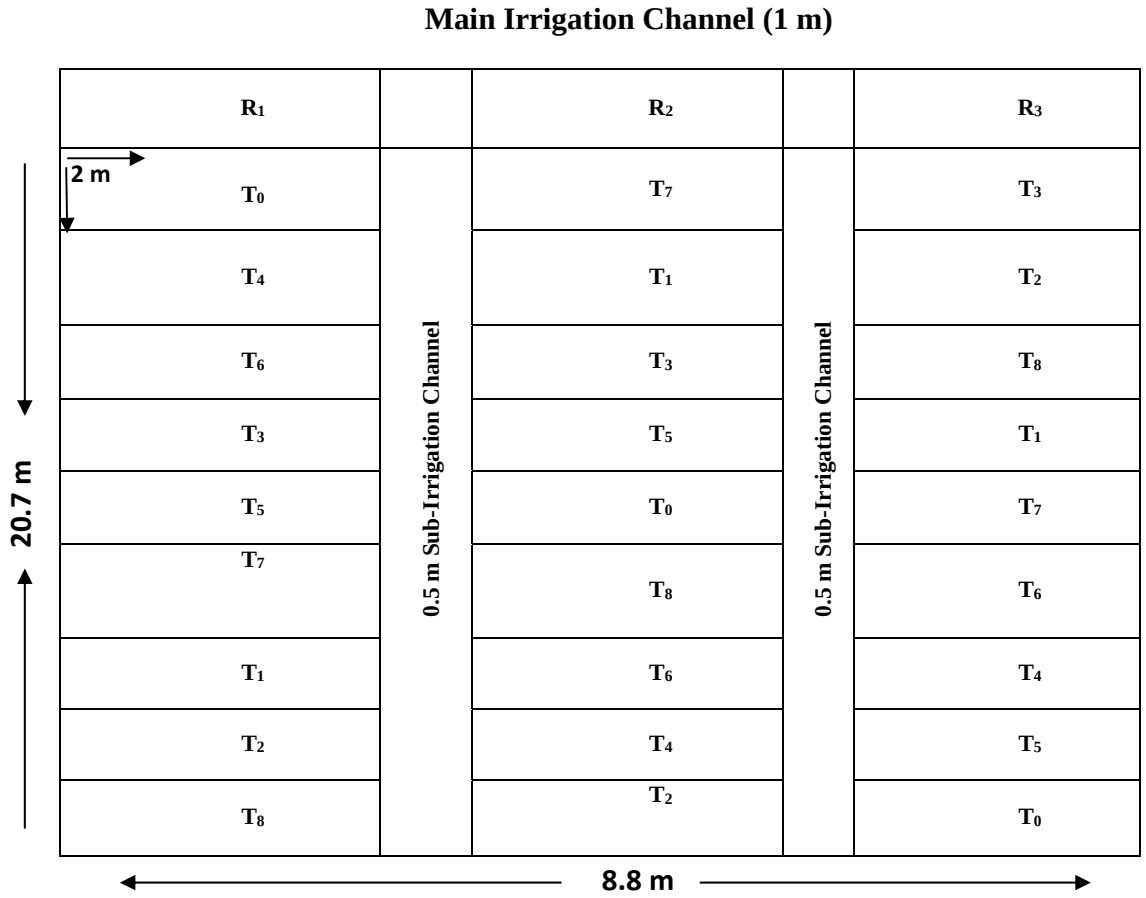
2.1 Study Area

The experimental site was situated in university campus jurisdiction in district Allahabad, U.P. The soil of this site belongs to order entisol having textural class sandy loam. The details of treatments and other relevant information are given below

(i) Treatment combinations

To	@ [NPK 0% RDF + Neem Cake 0 kg/ha]
T1	@ [NPK 0% RDF + Neem Cake 50 kg/ha]
T2	@ [NPK 0% RDF + Neem Cake 100 kg/ha]
T3	@ [NPK 50% RDF + Neem Cake 0 kg/ha]
T4	@ [NPK 50% RDF + Neem Cake 50 kg/ha]
T5	@ [NPK 50% RDF + Neem Cake 100 kg/ha]
T6	@ [NPK 100% RDF + Neem Cake 0 kg/ha]
T7	@ [NPK 100% RDF + Neem Cake 50 kg/ha]
T8	@ [NPK 100% RDF + Neem Cake 100 kg/ha]

(ii) Layout plan of experimental sites



2.2 Soil Sampling

Soil samples were obtained by augur from 0-15 and 15-30 cm depth and Collected in gunny bags brought to laboratory for analyses.

2.3 Samples Preparation

Samples were finally taken after series of coning and quartering the soil samples were air-dried for a period of one week in a clean well – ventilated laboratory homogenized by grinding, passed through a 2mm (10 mesh) stainless sieve and stored in labeled plastic cans ready than soil samples were processed properly and were analyzed in laboratory for desire soil constituents.

2.4 Analytical methods

The various methods were used in determination of following desire soil constituents

Physical properties at 0-15 and 15-30 cm depth. of soil.

Ingredient	Methods (Year)
Particle density(g cm^3)	Relative density bottle method (black,1965)
Bulk density (g cm^3)	Core method (Black,1965)
Pore – space (%)	Use of 100 ml Graduated Cylinder (Mathuwal *et al*.,1965

Chemical properties at 0-15 and 15-30 cm depth. of soil.

Ingredient	Methods (Year)
Soil pH (1:2)w/v	Digital pH meter (Jackson,1958)
EC(dS m^{-1})	Digital Conductivity meter (Wilcox,1950)
Organic carbon (%)	Walkley and Black method (1947)
Available Nitrogen (kg ha^{-1})	Alkaline permanganate method (subbiah and Asija,1956)
Available phosphorus (kg ha^{-1})	Colorimetric method (olsen *et al*.1954)
Available Potassium (kg ha^{-1})	Flame photometric method (Tooth and Prince 1949)

3. Result and Discussion

The initial and final values of physical properties and chemical properties are given below

Initial status of physical properties of soil at 0-15 and 15-30 cm depth

Ingredient	Result		Methods (Year)
	0-15 (cm)	15-30 (cm)	
Particle density (g cm^3)	2.420	2.431	Relative density bottle method (black,1965)
Bulk density (g cm^3)	1.313	1.299	Core method (Black,1965)
Pore – space (%)	51.97	51.75	Use of 100 ml Graduated Cylinder (Mathuwal *et al.*,1965)

Initial status of chemical properties of soil at 0-15 and 15-30 cm depth.

Ingredient	Result		Methods (Year)
	0-15 (cm)	15-30 (cm)	
Soil pH (1:2)w/v	7.15	7.28	Digital pH meter (Jackson,1958)
EC (dS m^{-1})	0.118	0.125	Digital Conductivity meter (Wilcox,1950)
Organic carbon (%)	0.453	0.383	Walkley and Black method (1947)
Available Nitrogen (kg ha^{-1})	218.25	202.37	Alkaline permanganate method (subbiah and Asija,1956)
Available phosphorus (kg ha^{-1})	18.51	15.38	Colorimetric method (olsen *et al*.1954)
Available Potassium (kg ha^{-1})	154.77	145.47	Flame photometric method Tooth and Prince 1949)

3.1 Final status of Physical properties of soil at 0-15 and 15-30 cm depth.

i) Particle Density (g/cm^3)

The maximum particle density (2.509 g/cm^{-3}) was found in treatment T_8-[NPK 100% RDF + Neem cake 100 kg/ha] on followed by T_7- [NPK 100% RDF + Neem cake 50 kg/ha] with (2.492 g/cm^{-3}) and the minimum value (2.419 g/cm^{-3}) particle density was found in treatment T_0 (Control). As 15 – 30 depth depicted the maximum particle density (2.543 g/cm^{-3}) was found in treatment T_8-[NPK 100% RDF + Neem cake 100 kg/ha] on followed by T_7- [NPK 100% RDF + Neem cake 50 kg/ha] with (2.499 g/cm^{-3}) and the minimum value (2.477 g/cm^{-3}) particle density (g/cm^{-3}) was found in treatment T_0 (Control).

ii) Bulk density (g/cm^3)

The maximum bulk density (1. 350 g/cm^2) in depth 0 - 15 found with T_8-[NPK 100% RDF + Neem cake 100 kg/ha] on followed by T_7- [NPK 100% RDF + Neem cake 50 kg/ha] with (1.341 g/cm^2) and the minimum value (1.285 g/cm^2) bulk density was found in treatment T_0 (Control). As 15 – 30 depth depicted the maximum bulk density (1.357 g/cm^2) was found in treatment T_8-[NPK 100% RDF + Neem cake 100 kg/ha] on followed by T_7- [NPK 100% RDF + Neem cake 50 kg/ha] with (1.341 g/cm^2) and the minimum value (1.296 g/cm^2) bulk density (g/cm^2) was found in treatment T_0 (Control).

ii) Pore space (%)

The maximum pore space (55.05 %) in depth 0 - 15 was foundT_8-[NPK 100% RDF + Neem cake 100 kg/ha] on followed by T_7- [NPK 100% RDF + Neem cake 50 kg/ha] with (54.04 %) and the minimum value (51.38 %) pore space was found in treatment T_0 (Control). As 15 – 30 depth the the maximum pore space (54.34 %) was found in treatment T_8-[NPK 100% RDF + Neem cake 100 kg/ha] on followed by T_7-[NPK 100% RDF + Neem cake 50 kg/ha] with (53.28 %) and the minimum value (50.34 %) pore space (%) was found in treatment T_0 (Control).

3.2 Final status of chemical properties of soil at 0-15 and 15-30 cm depth.

i) pH

The maximum pH (7.57) was found in T_0-(control) on followed by T_0-(control) on followed by T_3- [NPK @ 0% RD + Neem cake5 0 kg/ha] with (7.56) and the minimum value (7.40) pH was found in treatment T_8 (NPK @ 100% RD+- NPK @ 100% RDF). As depicted 15 – 30 depth the maximum pH (7.63) was found in treatment T_0-(control) on followed by T_3- [NPK @ 0% RD + Neem cake5 0 kg/ha] with (7.62) and the minimum value (7.50) pH (g cm^{-3})was found in treatment T_8 (NPK @ 100% RD+- NPK @ 50% RDF).

ii) Electrical conductivity (dSm^{-1})

The maximum electrical conductivity (0.192) in depth 0 - 15 was found with T_8-[NPK 100% RDF + Neem cake 100 kg/ha] on followed by T_7- [NPK 100% RDF + Neem cake 50 kg/ha] with (0.192) and the minimum value (0.155) electrical conductivity was found in treatment T_0 (Control). As 15 – 30 depth the maximum electrical conductivity (0.241) was found in treatment T_8-[NPK 100% RDF + Neem cake 100 kg/ha] on followed by T_7- [NPK 100% RDF + Neem cake 50 kg/ha] with (0.232) and the minimum value (0.198) electrical conductivity (dSm^{-1}) was found in treatment T_0 (Control).

iii) Organic Carbon (%)

The maximum Carbon (0.531 %) in depth 0 - 15 was found withT_8-[NPK 100% RDF + Neem cake 100 kg/ha] on followed by T_7- [NPK 100% RDF + Neem cake 50 kg/ha] with (0.513 %) and the minimum value (0.451 %) Carbon was found in treatment T_0 (Control). As 15 – 30 depth depicted the maximum Carbon (0.451 %) was found in treatment T_8-[NPK 100% RDF + Neem cake 100 kg/ha] on followed by T_7- [NPK

100% RDF + Neem cake 50 kg/ha] with (0.440 %) and the minimum value (0.339 %) Carbonwas found in treatment T_0 (Control).

Available nitrogen

The maximum available nitrogen (kg/ah) (236.04 kg/ha) in depth 0 - 15 was found with T_8-[NPK 100% RDF + Neem cake 100 kg ha^{-1}] on followed by T_7- [NPK 100% RDF + Neem cake 50 kg ha^{-1}] with (233.04 kg ha^{-1}) and the minimum value (177.26 kg ha^{-1}) available nitrogen was found in treatment T_0 (Control). As 15 – 30 depth the maximum available nitrogen (222.37 kg ha^{-1}) was found in T_8-[NPK 100% RDF + Neem cake 100 kg ha^{-1}] on followed by T_7- [NPK 100% RDF + Neem cake 50 kg ha^{-1}] with (218.70 kg ha^{-1}) and the minimum value (167.04 kg ha^{-1}) available nitrogen was found in treatment T_0 (Control).

Available phosphorus

The maximum available phosphorus kg ha^{-1} (22.37 kg ha^{-1}) in depth 0 - 15 was found with T_8-[NPK 100% RDF + Neem cake 100 kg ha^{-1}] on followed by T_7- [NPK 100% RDF + Neem cake 50 kg/ha] with (22.17 kg ha^{-1}) and the minimum value (16.70 kg ha^{-1}) available phosphorus was found in treatment T_0 (Control). As 15 – 30 depth the maximum available phosphorus (21.37 kg ha^{-1}) was found in treatment T_8-[NPK 100% RDF + Neem cake 100 kg ha^{-1}]on followed by T_7- [NPK 100% RDF + Neem cake 50 kg ha^{-1}] with (20.04 kg ha^{-1}) and the minimum value (15.04 kg ha^{-1}) available phosphorus was found in treatment T_0 (Control).

Available Potassium (kg/ha)

The maximum available potassium kg ha^{-1} (169.70 kg ha^{-1}) in depth 0 - 15 was found in T_8-[NPK 100% RDF + Neem cake 100 kg ha^{-1}] on followed by T_7- [NPK 100% RDF + Neem cake 50 kg ha^{-1}] with (168.37 kg ha^{-1}) and the minimum value (132.04 kg ha^{-1}) available potassium was found in treatment T_0 (Control). As 15 – 30 depth the maximum available potassium (162.70 kg ha^{-1}) was found in treatment T_8-[NPK 100% RDF + Neem cake 100 kg ha^{-1}]on followed by T_7- [NPK 100% RDF + Neem cake 50 kg ha^{-1}] with (158.70 kg ha^{-1}) and the minimum value (127.04 kg ha^{-1}) available potassium was found in treatment T_0 (Control).

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