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Effect of organic and inorganic sources of nutrients on soil health of cowpea (*Vigna unguiculata* L.) *Var*. Lobia black 665

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Abstract
The research work entitled "Effect of Organic and Inorganic sources of nutrients on soil health of Cowpea (*Vigna unguiculata* L.) *Var*. Lobia black 665, was conducted during *Zaid* season 2021-2022 on Central Research field. The experimental area of soil falls in order inceptisol. The design applied for statistical analysis was carried out with 2×2 RBD having 3 replications having 27 plots, with different NPK levels 0, 50, 100% and FYM levels 0, 50, 100%. The result shows combined use of NPK comprised of significant increase in that of soil fertility status. The physical properties observation of sample collected from 0-15cm and 15-30 cm shows Bulk density (Mg m^{-3}) Particle density (Mg m^{-3}) increasing by the soil depth whereas Pore space (%) and Water Holding Capacity (%) decreasing by the soil depth. Also the chemical properties observation of sample collected from 0-15cm and 15-30cm shows pH increasing by the soil depth and EC (dSm^{-1}),Organic Carbon %, Available Nitrogen (kg ha^{-1}), Available Phosphorus(kg ha^{-1}), Available Potassium(kg ha^{-1}) decreasing by the soil depth. The best treatment was T_9 (@100%NPK+@100%FYM) as compared to the other applied treatments respectively.

Keywords: Cowpea, NPK, FYM, physico-chemical properties etc.

Introduction
Cowpea is one of the most important legume vegetable belong to the family *Fabaceae*. It has synonyms like black eye, Southern pea, field pea, china bean and Crowder pea. The primary centre of origin is southern Africa and its cultivation spreads to east and West Africa and Asia. Cowpea is an annual herb having tap root system. Mainly grown for its pods as green vegetable during both summer and rainy seasons. Cowpea is of great importance due to its short duration, high yield capacity and rapid growth habit. It is relatively cheap source of vegetable protein which is essential for growth and maintenance of the body [1]. In India it is grown in the states like Punjab, Haryana, Delhi and west UP along with considerable area in Rajasthan, Karnataka, Kerala, Tamil Nadu, Maharashtra and Gujarat. Rajasthan is highest with an area of 12.31 lakh ha^{-1}, production of 5.73 lakhs ha^{-1} and productivity of 976 kg and followed by Gujarat with an area of 2.15 lakh ha^{1}, production of 2.10 lakh ha^{-1} and productivity of 465 kg ha^{-1} [2]. The proper nutrient management is one of the major factor for increasing the percentage of nutrient availability in the soil which influences better growth and development of the crop [3]. By using inorganic fertilizers along with organic manures increase the availability of NPK, Ca and Mg content in the soil [4]. Nitrogen is an important component, including chlorophyll and enzymes essential for plant growth process. It is essential component of amino acids and related proteins. Nitrogen is essential for carbohydrates use within plant and stimulates root growth and development as well as the uptake of other nutrients [5]. Legumes are Phosphorus loving plants, as it plays important role in many plant process such as energy metabolism, Nitrogen fixation, synthesis of nucleic acids and membrane photosynthesis enzyme regulation, respiration and initiation of nodule formation. Potassium plays a vital role in crop production it increases plant vigour, serves as a activator of various enzymes and disease resistance. Farm Yard Manure (FYM) is more valuable organic manure, helps in the improvement of soil due to its humus macro and micro nutrients contents, besides helps in the improvement of soil structure, aeration, Water Holding Capacity of soil. Also helps in the stimulation of the activity of micro-organisms that makes the plant to get the macro-micro nutrients through the biological processes.

Material and Methods

Experimental Details

The experiment is conducted at the research farm of Soil Science and Agricultural chemistry department of Soil Science and Agricultural Chemistry, Naini, SHUATS. During *Zaid* season of April 2021 - July 2021. The experiment is conducted in a Randomized Block Design (RBD) with three levels of inorganic fertilizers N, P, K (0, 50, 100% dosage) and FYM (0, 50, 100% dosage) respectively, the treatments are replicated into three time dividing the experimental area into 27 plots.

Fertilizer doses

As per the experimental recommendations the treatment combinations are as follows: T_1(@Absolute control), T_2(@0%NPK +@50% FYM), T_3(@0% NPK + @100% FYM), T_4(@50% NPK + @0% FYM), T_5(@50% NPK +@ 50% FYM),T_6(@50% NPK + @100% FYM),T_7(@100%NPK +@0% FYM), T_8 (@100%NPK + @50% FYM), T_9 (@100%NPK + @100%FYM).

Soil physical and chemical analysis

Soil samples were collected from two different depths *i.e.*,0-15cm and 15-30cm. Nine soil samples from each depth were taken. Soil samples were dried in the lab and sieved with 2mm sieve for further Physico-Chemical analysis. The physical analysis of soil was done to determine Bulk density (Mg m^{-3}), particle density (Mg m^{-3}), pore space %, Water Holding Capacity % and the chemical analysis of soil done to determine the Nitrogen, Phosphorus, Potassium, Organic Carbon, pH and Electrical Conductivity (EC). N content was estimated by Kjeldahl"s method. The P and K contents were determined by "Olsen colorimetric method" and flame Photometer respectively. The soil Organic Matter was estimated by "hydrochloric and oxidation method". The pH of soil was determined by Digital Electric pH meter and the EC was determined by Electrical Conductivity meter [7, 8, 9, 10, 11, 12, 13]. Mentioned below in the Table No.1.

Table 1: Electrical Conductivity meter Particular

Particular	Scientist, Year
Textural class (Sand, Silt, Clay) %	Bouyoucos, 1962
Bulk density (Mg m^{-3})	Muthuaval *et al.*, 1992
Particle density (Mg m^{-3})	
Pore space (%)	
Water holding capacity (%)	
Soil pH (1:2)(w/v)	Jackson, 1958
Soil EC (dSm^{-1})	Wilcox, 1950
Organic Carbon (%)	Walkley and Black, 1947
Available Nitrogen (kg ha^{-1})	Subbiah and Asija, 1956
Available Phosphorus (kg ha^{-1})	Olsen *et al.*, 1954
Available Potassium (kg ha^{-1})	Toth and Price,1949

Results and Discussion

These results of the present investigation topic entitled "Effect of organic and inorganic sources of nutrients on soil health and yield of Cowpea (*Vigna unguiculata* L.) *Var*. Lobia black 665 is summarised below:

Physical Parameters

The Physical properties observation of sample collected from 0-15cm and 15-30cm shows Bulk density (Mg m^{-3}) and Particle density(Mg m^{-3}) increasing by the soil depth whereas Pore space % and Water Holding Capacity % decreasing by the soil depth, as 0-15cm soil depth includes, Bulk density 1.132 Mg m^{-3}, Particle density 2.501 Mg m^{-3}, Pore space % 57.53% and Water Holding Capacity 59.48% whereas sample collected from 15-30cm soil depth includes, Bulk density 1.136 Mg m^{-3}, Particle density 2.503 Mg m^{-3}, Pore space % 56.29% and Water Holding Capacity 47.66% recorded in the treatment T_9(100% NPK+100%FYM) which is found to be the best treatment among other applied treatments similar findings were found by [14]

Chemical Parameters

The chemical properties observation of sample collected from 0-15cm and 15-30cm shows pH increasing by the soil depth and EC (dSm^{-1}),OC %, Available Nitrogen kg ha^{-1}, Available Phosphorus kg ha^{-1}, Available Potassium kg ha^{-1} found decreasing by the soil depth, as 0-15cm soil depth includes, pH 7.278 non-significant to treatments applied whereas EC 0.308(dSm^{-1}), OC 0.667%, Available Nitrogen 287.43 kg ha^{-1}, Available Phosphorus 27.63 kg ha^{-1}, Available Potassium 164.47 kg ha^{-1} found significant, whereas sample collected from 15-30cm soil depth includes pH 7.279 as non-significant whereas EC 0.305(dSm^{-1}), OC 0.664%, Available Nitrogen 287.33 kg ha^{-1}, Available Phosphorus 27.56 kg ha^{-1}, Available Potassium 164.31 kg ha^{-1} significant towards the treatments applied respectively which is found in the treatment T_9 (100% NPK+100%FYM) recorded as the best treatment among other applied treatments. The table below 02 and 03 summarizes about the physical and chemical analysis of the soil sample collected from 2 depths 0-15 and 15-30cm. Similar findings by [15].

Table 2: The physical analysis of the soil samples collected from 2 depths 0-15 cm and 15-30 cm as follows:

Treatments	Bulk density (Mg m^{-3})		Particle density(Mg m^{-3})		Pore space %		Water Holding Capacity %	
	0-15cm	15-30cm	0-15cm	15-30cm	0-15cm	15-30cm	0-15cm	15-30cm
T_1	1.382	1.387	2.352	2.354	44.86	42.56	48.33	37.39
T_2	1.364	1.366	2.373	2.376	46.34	45.82	49.98	38.24
T_3	1.342	1.345	2.401	2.405	47.92	47.91	52.06	40.12
T_4	1.293	1.297	2.407	2.409	50.55	48.78	53.87	41.28
T_5	1.271	1.273	2.426	2.428	52.42	50.78	55.12	43.37
T_6	1.248	1.249	2.443	2.447	53.52	51.76	56.48	44.27
T_7	1.236	1.238	2.472	2.475	55.51	54.13	57.17	45.36
T_8	1.174	1.177	2.497	2.499	56.88	55.55	58.15	46.48
T_9	1.132	1.136	2.501	2.503	57.53	56.29	59.48	47.66
F-Test	N S	NS	N S	N S	S	S	S	S
S.Ed	-	-	-	-	1.687	0.357	0.383	0.800
C.D(P=0.05)	-	-	-	-	0.789	0.763	0.820	1.710

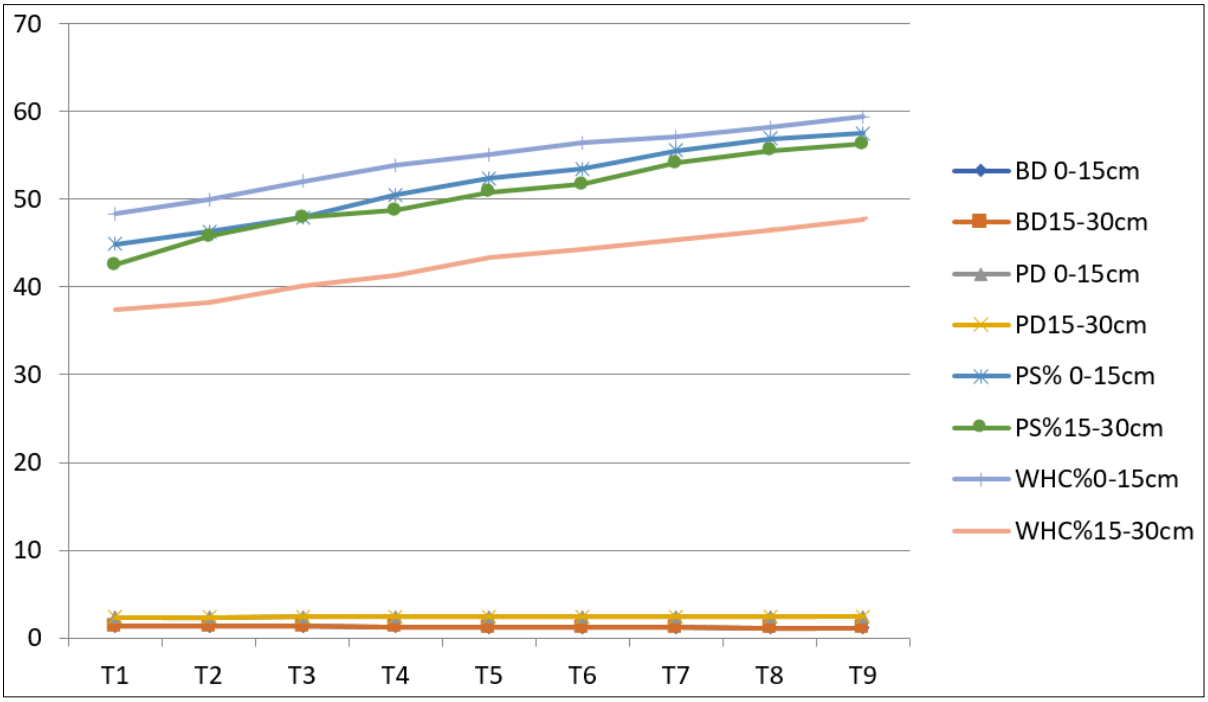

Fig 1: The physical analysis of the soil samples collected from 2 depths 0-15 cm and 15-30 cm

Table 3: The Chemical analysis of the soil samples collected from 2 depths 0-15 cm and 15-30 cm as follows:

Treatments	pH		EC		OC		Available N		Available P		Available K	
	0-15	15-30	0-15	15-30	0-15	15-30	0-15	15-30	0-15	15-30	0-15	15-30
T_1	7.561	7.563	0.362	0.360	0.510	0.507	259.76	259.62	19.38	19.23	130.48	130.32
T_2	7.552	7.559	0.353	0.351	0.523	0.520	261.72	261.61	21.46	21.31	135.31	135.23
T_3	7.486	7.488	0.336	0.334	0.542	0.541	275.65	275.63	21.40	21.34	138.41	138.34
T_4	7.543	7.547	0.345	0.342	0.564	0.562	279.51	279.46	22.85	22.61	139.22	139.07
T_5	7.551	7.556	0.351	0.350	0.576	0.573	280.02	280.01	23.30	23.14	142.42	142.36
T_6	7.364	7.367	0.338	0.337	0.584	0.582	280.76	280.65	24.11	24.02	147.67	147.45
T_7	7.366	7.369	0.312	0.310	0.610	0.605	281.39	281.28	24.62	24.44	151.48	151.37
T_8	7.335	7.336	0.311	0.309	0.632	0.631	282.65	282.57	25.44	25.22	158.49	158.38
T_9	7.278	7.279	0.308	0.305	0.667	0.664	287.43	287.33	27.63	27.56	164.47	164.31
F-Test	N S	N S	S	S	S	S	S	S	S	S	S	S
S.Ed	-	-	0.015	0.007	0.008	0.005	0.723	0.282	0.173	0.271	0.221	0.305
C.D(P=0.05)	-	-	0.032	0.016	0.017	0.012	1.547	0.603	0.369	0.579	0.472	0.653

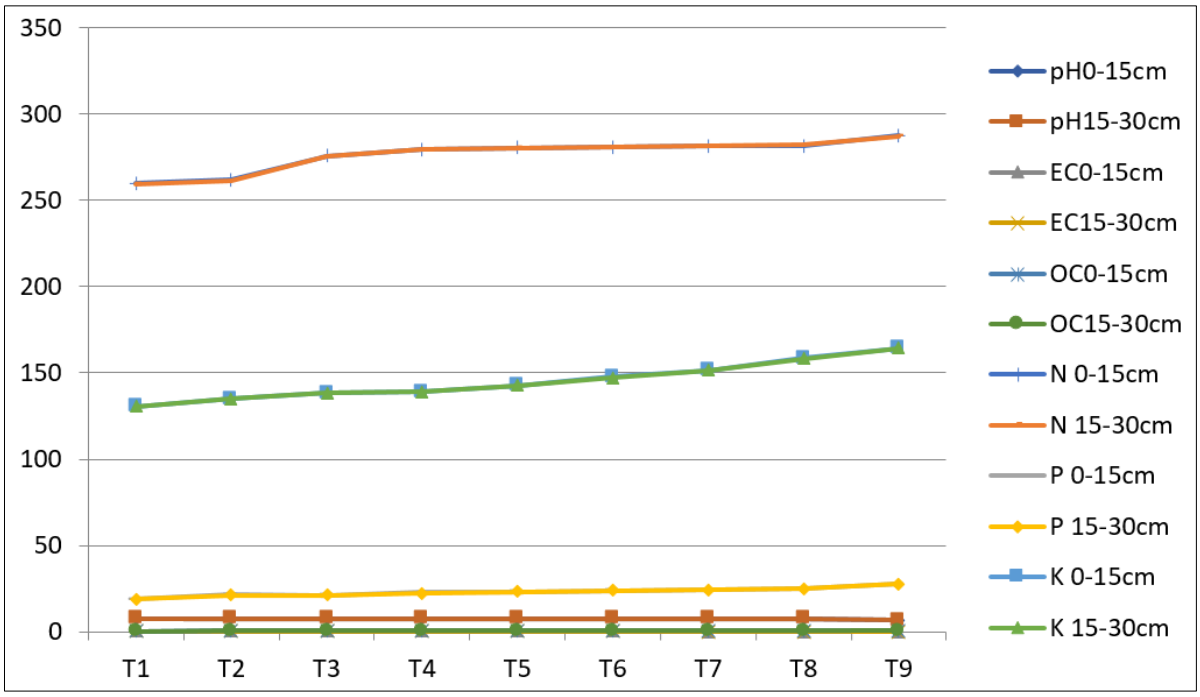

Fig 2: The Chemical analysis of the soil samples collected from 2 depths 0-15 cm and 15-30 cm

Conclusion

It is well proved that growth; yield and quality of plant are greatly influenced by availability of nutrients in the soil. So, the best way is to provide appropriate amount of organic and inorganic sources of nutrients to meet the crop nutrient demand and maintain fertility of soil. It was concluded from the experiment that the effect of different levels of NPK and FYM shown in post soil observations of treatment T9 applied (@100%NPK+@100%FYM) revealed that the application of NPK and FYM was excellent source for fertilization than fertilizers for obtaining of better yield and maintenance of soil fertility. The Soil parameters were observed maximum in treatment T9 and minimum was observed in the treatment T1(@control).

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