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Response of different level of nitrogenous fertilizer on soil health, morphological parameters and yield attributes of soybean (*Glycine max* L.) var. JS-9305

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Abstract
Research trial was carried out during *kharif* season of 2021 entitled "Response of different level of nitrogenous fertilizer on soil health, morphological parameters and yield attributes of soybean (*Glycine max* L.) Var. JS-9305" in inceptisol of Prayagraj. The experiment was laid down in randomized block design comprised three levels of nitrogen through Urea [0, 50 and 100 kg N ha^{-1}] and three level of nitrogen through Calcium ammonium nitrate (CAN) [0, 50 and 100 kg N ha^{-1}]. Significantly higher plant height, number of branches, number of seeds pod^{-1}, seed yield and straw yield.

Keywords: Soybean, soil parameters, nitrogen, urea, CAN, economic and yield

Introduction
Soybean (*Glycine max* L.) is an introduced and commercially exploited crop in India. The crop is also called as "Golden Bean" or "Miracle crop" of the 21th century on account of its multiple uses. It has highest protein 40-42%, Oil 20%, rich in lysine and vitamins A, B and D and also rich in mineral salts (Raghuveer *et al.*, 2017) [6]. Inspite of its high yielding potential, soybean productivity is much less in India. Among the factors responsible for low productivity, inadequate fertilizer use and emergence of multiple-nutrient deficiencies due to poor recycling of organic resources and unbalanced use of fertilizers are important Soybean is an rich energy crop and hence the requirement of major nutrients including secondary and micronutrients is high (Aziz *et al.*, 2015) [1]. Nitrogen is a major essential plant nutrient element. It has the quickest and most pronounced effect on plant growth and yield of crops. Plants receiving insufficient Nitrogen are stunted in growth with restricted root systems. The leaves turn yellow or yellowish green and tend to drop off (begam *et al.*, 2015). N demand for seed may be determined by the product of three factors: seed number, the rate of N filling in individual seeds, and the length of the reproductive period. N fertilization may not stimulate the rate of N filling in individual seeds when sink activities are limited (Ntambo *et al.*, 2017) [4]. CAN fertilizer neutral in nature and commonly known as kisan khad. Urea is most concentrated solid nitrogenous fertilizer N in Urea is readily fixed in soil in an ammonical form and is not lost in drainage. The Continuous use of Urea for several years than reduce the soil pH. N remobilization from vegetative body if external N supply meets N demand for seed production (Kinugasa *et al.*, 2011) [3]. Soybean plants obtain Nitrogen from three sources; 1. Nitrogen derived from biological N_2 fixation by root nodule; 2. Soybean's requirement for Nitrogen can be fulfilled by soil Nitrogen, high levels of Nitrogen in soil inhibit symbiotic N_2 fixation and under there condition, soil provides the majority of the plants needs for Nitrogen. Conversely, N_2- fixation supplied the majority of the plant's requirements for Nitrogen under conditions of low level of nitrogen in soil, and 3. Nitrogen from applied fertilizer. For optimum soybean yield, it is necessary to use both biological N_2- fixation and absorption of Nitrogen uptake by soybean roots (Poppvic *et al.*, 2017).

Material and Methods
The field experiment was conducted at Research Farm of Soil Science and Agricultural Chemistry at Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj. The area situated on the south of Prayagraj on right side of the river Yamuna on the south of Rewa road at distance of about 6 km from Prayagraj city.

It is situated at $25^0 24^I 21^{II}$ N latitude, $81^0 48^I 36^{II}$ E longitude and at the altitude of 98 meter above the sea level. The area of Prayagraj district comes under subtropical belt in the South east of Uttar Pradesh, which experience extremely hot summer and cold winter. The maximam temperature of the location reaches up to 46 ^{0}C – 48 ^{0}C and seldom falls as low as 4 ^{0}C – 5 ^{0}C. The relative humidity ranged between 20 to 94%. The average rainfall in this area in around 1100 mm annually Prayagraj has a sub- tropical and semi- arid climate with rain climate with mostly during July – September. The experiment comprised two fertility level of (control, 100% RDF), three level of nitrogen through Urea [control, 50 and 100 kg N ha^{-1}] and also three level of nitrogen through Calcium ammonium nitrate (CAN) [control, 50 and 100 kg N ha^{-1}]. One of the treatment combinations comprised the recommended doses of 40 kg N, 60 kg P_2O_5 and 40 kg K_2O per hectare. Recommended dose of P_2O_5 (60 kg ha^{-1}) in form DAP (Di-ammonium Phosphate) and K_2O (40 kg ha^{-1}) in form of MOP (Muriate of Potash) was applied at the time of sowing. Urea and CAN were applied as split as per the treatments. The crop was harvested at its physiological maturity. The data was statistically analysed as per the procedure given by Aziz *et al.*, 2015 [1].

Results and Discussion

As depicted in table 2 shows that the maximum bulk density of soil (Mg m^{-3}), was found in T_1 (Control) which was 1.207 and minimum found in T_9 (100 kg ha^{-1} Urea + 100 kg ha^{-1} CAN) which was 1.194. This is show that the maximum particle density of soil (Mg m^{-3}), was found in T_1 (Control) which was 2.238 and minimum found in T_9 (100 kg ha^{-1} Urea + 100 kg ha^{-1} CAN) which was 2.225. The results shows that the maximum pore space (%) of soil, was found in T_9 (100 kg ha^{-1} Urea + 100 kg ha^{-1} CAN) which was 47.78 and minimum found in T_1 (Control) which was 45.12. The results shows that the maximum water holding capacity (%) of soil, was found in T_9 (100 kg ha^{-1} Urea + 100 kg ha^{-1} CAN) which was 49.92 and minimum found in T_1 (Control) which was 34.13.This shows that the maximum pH of soil, was found in T_9 (100 kg ha^{-1} Urea + 100 kg ha^{-1} CAN) which was 7.90 and minimum found in T_1 (Control) which was 7.61. The results shows that the electrical conductivity (dS m^{-1}) of soil, was found in T_9 (100 kg ha^{-1} Urea + 100 kg ha^{-1} CAN) which was 0.258 and minimum found in T_1 (Control) which was 0.241. This is show that the maximum organic carbon of soil (%), was found in T_1 (Control) which was 0.330 and minimum found in T_9 (100 kg ha^{-1} Urea + 100 kg ha^{-1} CAN) which was 0.201. The results shows that the maximum N P K (kg ha^{-1}) of soil, was found in T_9 (100 kg ha^{-1} Urea + 100 kg ha^{-1} CAN) which was 250.42, 22.07, 158.62 kg ha^{-1} and minimum found in T_1 (Control) which was 230.07, 15.41, 139.82 kg ha^{-1}. The maximum plant height (cm) reported in T_9 (100 kg ha^{-1} Urea + 100 kg ha^{-1} CAN) 104.06 and minimum in T_1 (Control) 80.21 at harvest. The maximum number of branches plant^{-1}, number of pods plant^{-1} and number of seed pod^{-1} in T_9 (100 kg ha^{-1} Urea + 100 kg ha^{-1} CAN) 6.65, 45.82, 5.44, and minimum in T_1 (Control) 3.47, 25.32, 1.99. This is shows that the maximum seed yield (kg ha^{-1}) was found in (100 kg ha^{-1} Urea + 100 kg ha^{-1} CAN) 2437.25 and minimum found in T_1 (Control) which was 1040.91. This is shows that the maximum straw yield (kg ha^{-1}) was found in (100 kg ha^{-1} Urea + 100 kg ha^{-1} CAN) 3515.34 and minimum found in T_1 (Control) which was 1792.52. The results are similar with the finding of Xu *et al.*, (2020) [7]

Table 1: Physical- Chemical Properties

Analysis	Particulars	Results
Physical Properties		
	Sand (%)	61.32
	Silt (%)	24.61
	Clay (%)	14.40
	Texture Class	Sandy loam
	Soil Colour	Pale Brown
	Bulk Density (Mg m^{-3})	1.198
	Particle Density (Mg m^{-3})	2.232
	Pore space (%)	46.26
	Water Retaining Capacity (%)	41.62
Chemical Properties		
	Soil pH	7.40
	Electrical Conductivity (dS m^{-1})	0.235
	Organic Carbon (%)	0.207
	Available Nitrogen (kg ha^{-1})	240.21
	Available Phosphorus (kg ha^{-1})	18.23
	Available Potassium (kg ha^{-1})	160.01

Table 2: Response of different levels of Nitrogenous fertilizer on soil properties

Treatment	BD (Mg m^{-3})	PD (Mgm^{-3})	WHC (%)	PS (%)	pH (w/v)	EC (dS m^{-1})	OC (%)	N (kg ha^{-1})	P (kg ha^{-1})	K (kg ha^{-1})
T_1	1.207	2.238	34.13	42.52	7.61	0.241	0.201	230.07	15.41	139.82
T_2	1.203	2.235	39.02	42.61	7.62	0.246	0.292	231.09	18.33	140.31
T_3	1.198	2.230	46.43	42.65	7.64	0.252	0.313	234.16	20.42	143.42
T_4	1.206	2.234	38.16	42.48	7.68	0.243	0.279	235.21	15.04	145.51
T_5	1.205	2.231	41.45	42.64	7.74	0.249	0.303	238.35	19.98	149.62
T_6	1.195	2.227	46.09	42.72	7.79	0.255	0.316	240.77	21.64	153.26
T_7	1.199	2.233	44.48	42.73	7.85	0.251	0.307	243.31	20.05	156.31
T_8	1.197	2.226	47.63	42.74	7.88	0.254	0.315	245.99	21.95	157.42
T_9	1.194	2.225	49.42	42.79	7.90	0.258	0.330	250.42	22.07	158.62
S.Em (±)	0.006	0.023	0.561	0.59	0.05	0.005	0.002	3.78	0.51	2.39
C.D.	0.012	0.054	0.853	1.23	0.14	0.014	0.007	11.33	1.54	7.16

Note: BD- Bulk Density, PD- Particle Density, WHC- Water Holding Capacity, PS- Pore Space, EC- Electrical Conductivity, OC- Organic Carbon, N-Nitrogen, P- Phosphorus, K- Potassium

Table 3: Morphological parameters and yield attributes

Treatment	Plant height (cm)	No. of branches plant^{-1}	No. of Pods plant^{-1}	No. of seed pod^{-1}	Seed Yield (kg ha^{-1})	Straw Yield (kg ha^{-1})
T_1	80.21	3.47	25.32	1.99	1040.91	1792.52
T_2	84.94	4.86	30.07	2.86	1465.25	2346.48
T_3	92.85	6.04	40.88	3.37	2286.25	2908.71
T_4	82.04	4.34	28.86	2.48	1416.36	2274.27
T_5	90.31	5.14	42.21	3.14	1812.25	2666.89
T_6	96.50	6.28	46.25	4.25	2363.36	3328.51
T_7	89.03	5.67	43.42	3.33	2166.25	2884.65
T_8	98.45	5.78	45.31	4.07	2316.36	3143.13
T_9	104.06	6.65	52.82	5.44	2437.25	3515.34
S.Em (±)	0.69	0.18	0.34	0.15	1.52	36.11
C.D.	2.06	0.55	1.03	0.44	4.54	108.27

Summary

The soil parameter such as Bulk density **(**Mg m^{-3}), Particle density **(**Mg m^{-3}), Porosity (%), Water holding capacity (%), Soil pH, Electrical conductivity (dS m^{-1}), Organic carbon (%), available Nitrogen (kg ha^{-1}), available Phosphorus (kg ha^{-1}), and available Potassium (kg ha^{-1}). The Growth and yield parameters were significantly influenced by application of different combination nitrogenous fertilizer such as Plant height (cm)**,** Number of branches plant^{-1}**,** No. of pod plant^{-1}, No. of seed pod^{-1}, Seed yield (kg ha^{-1}), Straw yield (kg ha^{-1}). However maximum Plant height (cm) (20.89, 73.19 and 104.06 at 30 DAS**,** at 60 DAS and at harvesting respectively)**,** number of branch plant^{-1} (6.65), No. of pod plant^{-1} (74.82), No. of seed pod^{-1} (4.44), Seed yield (2437.25 kg ha^{-1}), Straw yield (3515.34 kg ha^{-1}).

Conclusion

It is concluded from the trail that the effect of different levels in the experiments, The treatment T_9 [Urea100% + CAN100%] was best treatment combinations with respect to Bulk density, particle density, pore space, water holding capacity, pH, EC, Organic Carbon, available N, P, K on soil. It concluded from trail the effect of different levels in the experiment, the best treatment was T_9 which showed the highest plant height, highest yield.

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