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Assessment of Physico-chemical Properties of Soil as Influenced by Different Moisture Regimes and Nitrogen Sources in Wheat Crop

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

An experiment was conducted at Student's "Instructional farm of Acharya Narendra Deva University of Agriculture and Technology Kumarganj, Ayodhya (U.P.) during *rabi* season 2019-2020. The experiment was laid out in split plot design (SPD) with three replications using the wheat variety HD- 2967. The treatments comprised of four levels of irrigation *viz.* 0.6 IW/CPE ratio (I_1), 0.8 IW/CPE ratio (I_2), 1.0 IW/CPE ratio (I_3), 1.2 IW/CPE ratio (I_4), and three nitrogen sources viz. 100% (RDF) through urea (N_1), 50% RDF + 50% FYM (N_2), 50% RDF + 50% poultry manure (N_3).The build-up in organic carbon was found with the application of moisture regime at 1.2 IW/CPE and the minimum was received with the moisture regime at 0.6 IW/CPE during the investigation. The increment level of available nitrogen, phosphorus, potassium and zinc were found with the increasing level of moisture regime. The maximum was found with the application of moisture regime at 1.2 IW/CPE and the minimum was received with the moisture regime at 0.6 IW/CPE during the investigation. Moisture regimes 1.2 IW/CPE ratio was found best for viz., p^H , EC and organic carbon, Available Nitrogen, Phosphorus , Potassium & Zinc and among the Nitrogen level, application of 50% N from urea + 50% N from Poultry manure (N_3) was found suitable for soil fertility status followed by 50% N from urea +50% N from FYM (N_2)

Keywords: Wheat; moisture regime; nitrogen sources; soil fertility.

1. INTRODUCTION

The most significant cereal crop in the world is wheat (*Triticum aestivum* L.). When it comes to production and area among the major grains, wheat tops the list and provides the primary source of nutrition for around 40 % of the world's population [1].

In India wheat is the second-most significant grain crop and is crucial to the nation's food and nutritional security. It currently ranks second to rice as the primary food source for humans in terms of total food production [2].

Irrigation should aim to restore soil water in the root zone to a level at which crop can fully meet its evapotranspiration requirement. The amount of water to be applied at each irrigation and how often a soil should be irrigated depends, however on several factors such as the degree of soil water deficit before irrigation, soil type, crops and climatic conditions [3]. There is a positive correlation between grain yield and irrigation frequencies [4].

Nitrogen is one of the major essential elements which influence the growth, yield and quality of wheat more than any other single nutrient element [5]. Organic manures, such as FYM, vermicompost and poultry manure act as a good reservoir of nutrients and water in the soil, which helps to improve soil structure, increase soil infiltration and promote the growth and population of beneficial soil microorganisms [6]. The increase in eco-friendly production of wheat can be made possible by widespread adoption of improved Technologies of which fertilizer management particularly that of nitrogen and organic manure can play a key role.

Compost alone and in combination with chemical fertilizer in the same level reduced the soil pH, increased electrical conductivity, available phosphorus, water soluble potassium and organic matter status of soil [7]. while addition of organic material to the soil such as farm yard manure (FYM) helps in maintaining soil fertility and productivity. It increases soil microbiological activities, plays key role in transformation, recycling and availability of nutrients to the crop [8]. It also improves the physical properties like soil structure, porosity, reduces compaction and crusting and increases water holding capacity of soil [9].

2. MATERIALS AND METHODS

2.1 Site Description

The field experiment was conducted during Rabi season 2019-2020 at Student's "Instructional farm of Acharya Narendra Deva University of Agriculture and Technology Kumarganj, Ayodhya Uttar Pradesh, India, on the left side of Ayodhya-Raibareilly road at a distance of 43 km away from Ayodhya district headquarter.

The local of experimental site lies between a 26.470 N latitude, 52.120 E longitude and an altitude of 113 meters from mean sea level in the gangetic alluvium of eastern Uttar Pradesh. This regions falls under the sub-tropical climate of Indo-Gangetic plains of eastern Uttar Pradesh (India) having alluvial sodic soil. The climate of the area is subtropical and semi- arid with an average annual rainfall of about 1070 mm.

Wheat HD-2967 variety was taken for experiment, it is most suitable for north eastern plain zones of India, which includes a part of Uttar Pradesh also. It is an early maturity variety (135-150 days.) Its average yield is 40- 50 quintals per hectare. The experiment was laid out in split plot design (SPD) with three replications.

2.2 Scheduling of Irrigation

According to the irrigation schedules for the relevant treatment, a set amount of 60 mm of water was applied to the relevant experimental plots. For better crop establishment, uniform irrigation was applied to all treatments right away after sowing, regardless of the treatments. The USWB class 'A' open pan evaporimeter situated at the meteorological observatory, which was close to the experimental plot, was used to measure the daily pan evaporation, from which the cumulative pan evaporation data were computed. Each treatment received a set depth of irrigation water of 60 mm based on an IW: CPE ratio.

The cumulative pan evaporation (CPE)varied with IW/CPE ratio and hence irrigation based on IW/CPE applied.

$$IW/CPE = \frac{\text{Irrigation water depth (mm)}}{\text{Cummulative pan evoporation (mm)}}$$

CPE is the sum of daily pan evaporation recorded from an open pan evaporimeter. Whenever, cumulative pan evaporation value reached at respective desired level, the irrigation was given as per treatment. Effective rainfall occurred during the crop growth period was also taken into consideration by subtracting it from CPE of that treatment levels.

The time of irrigation in each plot was given on the basis of formula

$$t = \frac{\mathbf{ad}}{\mathbf{q}}$$

With

t is the = time of application of water
a is the= area of plot to be irrigated m^2
d is the = depth of water (cm) and
q is the = discharge rate, (liter /sec)

2.3 Soil Sampling and Proprieties

The fertility status of soil texture, bulk density, pH, Electrical conductivity and organic carbon, Soil moisture percentage before irrigation and after irrigation have been determined. Soil sampling was done before and after irrigation with the help of soil auger. Briefly soil sample were put on the moisture box for getting accurate moisture percentage. Then soil sample were weighted in a container and dried for 24 hours at the temperature of 105 ^{0}C in oven. In the end, the soil samples were reweigh the weight of the container was subtracted and the moisture percentage was calculated following the formula of

Soil Moisture Content (%) = WS1-WS2/WS2x 100

With,

WS_1 is the = weight of fresh soil sample and
WS_2 is the = weight of oven dried soil samples

2.4 Statistical Analysis

Statistical analysis of treatment on the pattern of split plot design was carried out following the procedure as given by Fisher and Yates (1940). The degree for various factors is given accordingly.

Table 1. Treatment details

Treatment	Irrigation Water depth (IW) mm	Cumulative Pan Evaporation CPE (mm)	IW/CPE ratio
I1	60	100	0.6
I2	60	75	0.8
I3	60	60	1.0
I4	60	50	1.2

The standard error of mean and critical difference was calculated by the following formula:

(a) Moisture regimes

$$\text{CD at 5\%}= \frac{\sqrt{2\text{EMS(a)}}}{\text{r}\times\text{t}} \times \text{t } 0.05 \text{ error (a)d.f.}$$

(b) Nitrogen sources

$$\text{CD at 5}= \frac{\sqrt{2\text{ EMS(b)}}}{\text{r}\times\text{n}} \times \text{t } 0.05 \text{ error (b)d.f.}$$

3. RESULTS AND DISCUSSION

3.1 Physico-chemical Properties of Soil as influenced by Different Moisture Regimes and Nitrogen Sources

3.1.1 Soil pH and electrical conductivity

Data pertaining to soil pH as influenced by different moisture regimes and nitrogen sources. The reduction in pH was observed with the application of the four treatments irrigation. However no clear trend has been found with moisture regime and sources of nitrogen.

Among the nitrogen sources the data showed that the soil pH did not more effected by (100% RDF), N_1, 50% N from urea +50% N from FYM (N_2), 50% N from urea + 50% N from Poultry manure (N_3) Table 2.

The reduction in soil pH with the application irrigation on the basis of IW/CPE ratio might be due to dilution of salts and leaching of ions beyond the root zone. The use of organic manures viz., poultry manure and FYM has also been known to help in reducing the soil pH to some extent by producing organic acids while their decomposition that may also be the reason of greater availability and mobility of nutrients mainly of micronutrients. These findings are corroborated by Jat et al. [10].

3.1.2 Organic carbon

The observation regarding the organic carbon in gkg^{-1} presented in Table 3. Revealed that a slight improvement in organic carbon was obtained with increasing level of moisture regime up to 1.2 IW/CPE ration. It could be due to the decomposition of organic residues and release of solubilized plant nutrients with maintaining the proper soil moisture levels [11].

Among the application of recommended doses of fertilizer and apply the organic manures along with inorganic fertilizer enhanced in build-up of organic carbon. The maximum organic carbon (4.89 gkg^{-1}) was obtained with the application N_3- 50% RDF+ 50% N through poultry manure followed by N_2- 50%RDF+ 50%N through FYM. The minimum was recorded with the application recommended doses of fertilizer.

3.2 Available Nitrogen, Phosphorus Potassium and Zinc of Soil as influenced by Different Moisture Regimes and Nitrogen Sources at harvest of the crop

Slight increment was received with the increasing soil moisture regime up to 1.2 IW/CPE ratio. The lower value was obtained with 0.6 IW/CPE Table 2.

In respect of nitrogen sources which were applied as 100% RDF, 50% RDF+ 50% through FYM and 50% through RDF+ 50% Poultry Manure.

The maximum nutrients viz N, P, K and Zn were analyzed at after harvest of the crop with the application Nitrogen through 50% RDF+ 50% Poultry manure. The minimum was received with the application of 100% RDF through inorganic fertilizer. The build-up of available nutrients with the application irrigation on the basis of IW/CPE ratio might be due to dilution of salts and leaching of ions beyond the root zone. Use of organic manures viz., poultry manure and FYM has released the availability and mobility of nutrients after the decomposition mineralization organics sources of nutrients mainly of micronutrients. These findings are corroborated by Saha et al. [12].

Table 2. Physico-chemical Properties of Soil as influenced by Different Moisture Regimes and Nitrogen Sources

Treatment	Soil Texture	Bulk Density ($Mg\ m^{-3}$)	Moisture(%) Before irrigation	Moisture (%) after irrigation
Moisture regimes				
0.6 IW/CPE ratio	Silt loam	1.42	11.42	21.5
0.8 IW/CPE ratio	Silt loam	1.42	12.1	21.8
1.0 IW/CPE ratio	Silt loam	1.43	12.3	22.2
1.2 IW/CPE ratio	Silt loam	1.43	12.5	22.5
SEm±			0.36	0.56
CD at 5%			1.25	1.75
Nitrogen sources				
100% N from urea (N_1)	Silt loam	1.42	11.20	21.23
50% N from urea +50% N from FYM (N_2)	Silt loam	1.40	13.20	23.20
50% N from urea + 50%N from Poultry manure (N_3)	Silt loam	1.41	13.40	23.60
SEm±			0.37	0.57
CD at 5%			1.14	1.82

Table 3. The variation of pH, electrical conductivity (EC) and organic carbon (OC) with respect of different treatments

Treatment	pH	EC (dSm^{-1})	OC ($g\ kg^{-1}$)
Moisture regimes			
0.6 IW/CPE ratio	8.20	0.32	4.22
0.8 IW/CPE ratio	8.23	0.31	4.43
1.0 IW/CPE ratio	8.20	0.31	4.45
1.2 IW/CPE ratio	8.20	0.31	4.68
SEm±	0.17	0.004	0.37
CD at 5%	0.58	0.016	2.23
Nitrogen sources			
100% N from urea (N_1)	8.05	0.31	4.44
50% N from urea +50% N from FYM (N_2)	8.05	0.31	4.68
50% N from urea + 50% N from Poultrymanure (N_3)	8.00	0.32	4.89
SEm±	0.17	0.005	0.46
CD at 5%	0.53	0.014	1.34

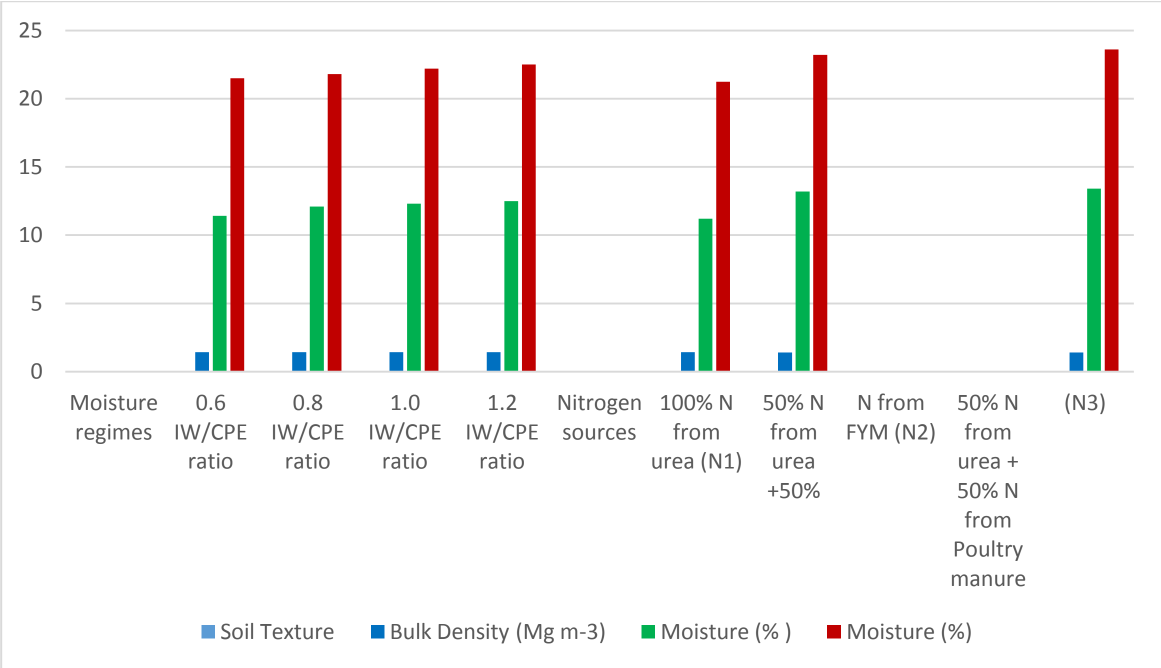

Fig. 1. Bulk density, moisture % before and after irrigation of soil as influenced by different moisture regimes and nitrogen sources

Table 4. Available N, P, K& Zn of soil as influenced by different moisture regimes and nitrogen sources

Treatment	**Available Nutrients (kg/ha^{-1})**			
	Nitrogen (kgha^{1})	**Phosphorus (kgha^{1})**	**Potassium (kgha^{1})**	**Zinc (mgha^{1})**
Moisture regimes				
0.6 IW/CPE ratio	210.47	16.50	250.67	0.54
0.8 IW/CPE ratio	211.64	17.07	250.80	0.55
1.0 IW/CPE ratio	211.67	17.23	254.67	0.55
1.2 IW/CPE ratio	212.83	17.57	257.00	0.56
SEm±	2.24	0.41	1.90	0.02
CD at 5%	NS	NS	6.41	0.08
Nitrogen sources				
100% N from urea (N1)	212.93	16.28	250.87	0.58
50% N from urea +50% N from FYM (N2)	214.88	16.50	250.50	0.56
50% N from urea + 50% N from Poultry manure (N3)	216.93	16.65	254.77	0.64
SEm±	2.29	0.28	2.01	0.029
CD at 5%	NS	NS	NS	NS

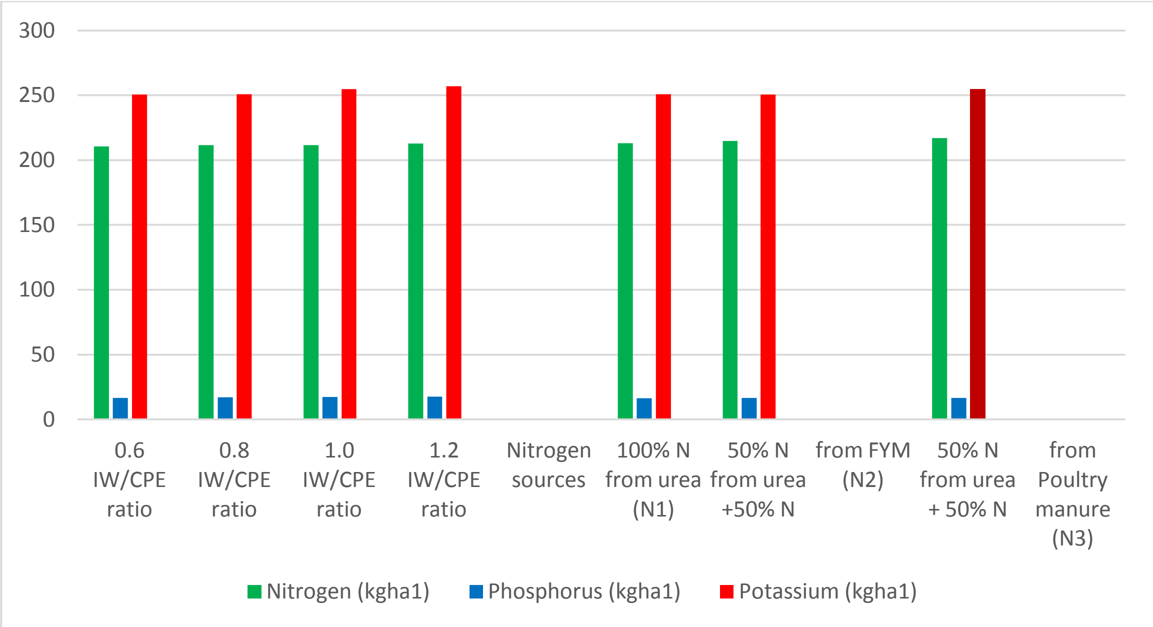

Fig. 2. Available N, P, K& Zn of soil as influenced by different moisture regimes and nitrogen sources

4. CONCLUSION

Moisture regimes 1.2 IW/CPE ratio was found best for viz., $p^{H,}$ EC and organic carbon, Available Nitrogen, Phosphorus, Potassium & Zinc the minimum was received with the moisture regime at 0.6 IW/CPE during the investigation and among the Nitrogen Sources, application of 50% N from urea + 50% N from Poultry manure (N_3) was found suitable for soil fertility status followed by 50% N from urea +50% N from FYM (N_2).

CONFERENCE DISCLAIMER

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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