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

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 2019-20. 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 moistureregimeat1.2IW/CPEandtheminimumwasreceivedwiththemoistureregimeat 0.6IW/CPE duringthe investigation. The increment level of available nitrogen, phosphorus, potassium and zincwere found with the increasing level of moisture regime. The maximum wasfoundwiththeapplicationofmoistureregimeat1.2IW/CPEandtheminimum was received with the moisture regime at 0.6 IW/CPE during theinvestigation.

Keywords: Wheat, Moisture Regime, Nitrogen Sources, Soil fertility

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 35% of the world's population. Wheat is the second-most significant grain crop in India and is crucial to the nation's food and nutritional security. With a higher protein content than either rice or maize, it is the main source of protein in human cuisine. It currently ranks second to rice as the primary food source for humans in terms of total food production.

Water is essential at every developmental phase starting from seed germination to plant maturation for harvesting the maximum potential yield of wheat. There is a positive correlation between grain yield and irrigation frequencies (Kumar*et al*., 2012).

Irrigation should aim to restore soil water in the root zone to a level at whichcrop can fully meet its evapotranspiration requirement. The amount of water to beapplied at each irrigation and how often a soil should be irrigated depends, however onseveral factors such as the degree of soil water deficit before irrigation, soil type, cropsandclimatic conditions (Debaeke *et al*.,2004).

Nitrogen is one of the major essential elements which influence the growth, yield and quality of wheat more than any other single nutrient element (Tamim Fazily 2020).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 (Singh *et al*., 2020).

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. Use of organic manures like farm yard manure (FYM), goat manure, poultry litter etc. for crop production might be a substitute of the chemical fertilizers. The use of fertilizer is very essential for better crop production(Singh*et al*., 2013).

Compost alone and in combination with chemical fertilizer in the same level reduced the soil pH, increasing electrical conductivity, available phosphorus, water soluble K and organic matter status of soil significantly (Kumar *et al*., 2023).

Addition of organic material to the soil such as farm yard manure (FYM) helpsin maintaining soil fertility and productivity. It increases soil microbiological activities,plays key role in transformation, recycling and availability of nutrients to the crop. Italso improves the physical properties like soil structure, porosity, reduces compactionand crusting and increases water holding capacity of soil (Verma *et al*., 2018).

Materials and methods

Site description

The field experiment was conducted during Rabi season 2019-20 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.

Climate in brief

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.

Variety details

HD – 2967variety 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.

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 of 0.6, 0.8, 1.0, and 1.2, respectively.

Afixedirrigationdepth(6cm)wasapplied.Thecumulativepanevaporation(CPE)variedwithIW/CPE ratioand henceirrigation basedonIW/CPEappliedas;

I_1= 6 cm depth of irrigation at 0.6 IW/CPE ratio (CPE = 100 mm)I_2=6depth ofirrigation at0.8IW/CPE ratio(CPE =75mm)

I_3= 6 depth of irrigation at 1.0 IW/CPE ratio (CPE = 60mm)I_4=6depthofirrigationat1.2IW/CPEratio(CPE=50mm)

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

CPEisthesumofdailypanevaporationrecordedfromanopenpanevaporimeter.Whenever,cumulativepanevaporationvaluereachedatrespectivedesired level, theirrigation wasgivenaspertreatment. Effectiverainfalloccurredduring the crop growth period was also taken into consideration by subtracting it fromCPEofthat treatment levels.

Thetimeofirrigationineachplotwasgivenonthebasisofformulagivenas under

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

Where,

t=timeofapplicationofwater

a = area of plot to be irrigated m^2

d=depth of water(cm)

q=dischargerate,(liter/sec)

Soil sampling

Soil sampling done at before and after irrigation with the help of soil auger. Soilsample was put on themoisture box for getting accurate moisture percentage. Weightthe container with soil sample and dry the sample for 24 hours at the temperature of 105^0C in oven then reweigh the sample, subtract the weight of the container, and thencalculatethemoisturepercentage with followingformula-

SoilMoistureContent(%)= WS1-WS2/WS2x100

Where,

WS_1=weightoffreshsoilsample.

WS_2=weightofovendriedsoilsample

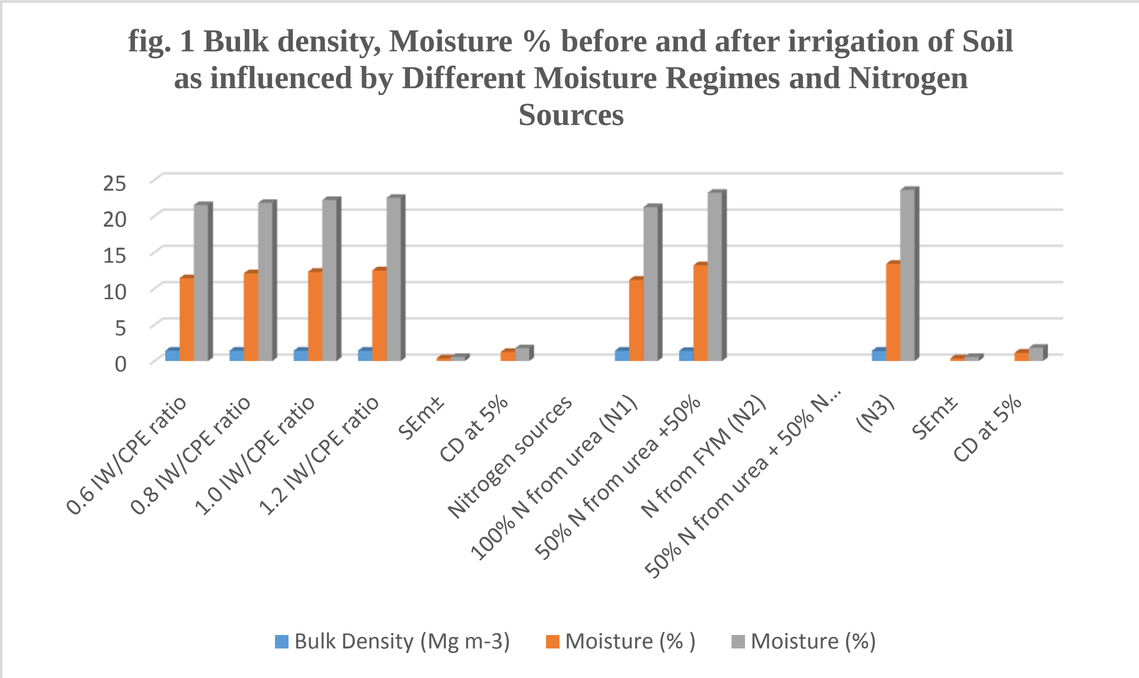
Result and Discussion

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

The fertility status of soil Texture, bulk density, pH, Electrical conductivity,organiccarbonSoilmoisturepercentagebeforeirrigationandafterirrigationhavebeenpresentedin

Table1.Physico-chemical Properties of Soil as influenced by Different Moisture Regimes and Nitrogen Sources

Treatment	SoilTexture	Bulk Density(Mgm^{-3})	Moisture(%) Beforeirrigation	Moisture (%) afterirrigation
Moistureregimes				
0.6IW/CPEratio	Siltloam	1.42	11.42	21.5
0.8IW/CPEratio	Siltloam	1.42	12.1	21.8
1.0IW/CPEratio	Siltloam	1.43	12.3	22.2
1.2IW/CPEratio	Siltloam	1.43	12.5	22.5
SEm±			**0.36**	**0.56**
CDat 5%			**1.25**	**1.75**
Nitrogensources				
100%N from urea(N_1)	Siltloam	1.42	11.20	21.23
50%N from urea+50% NfromFYM (N_2)	Siltloam	1.40	13.20	23.20
50%Nfromurea+50%Nfrom Poultrymanure (N_3)	Siltloam	1.41	13.40	23.60
SEm±			**0.37**	**0.57**
CDat 5%			**1.14**	**1.82**



SoilpHandElectricalconductivity

Data pertaining tosoilpH asinfluencedby differentmoistureregimesandnitrogensources.ThereductioninpHwereobtainedwiththeapplic ationofirrigation0.6 IW/CPEratio(8.20),0.8IW/CPEratio(8.23),1.0IW/CPEratio(8.20),1.2IW/CPEratio8.20). However there 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 effectedby (100%RDF),N_1,50%Nfromurea+50%NfromFYM(N_2),50%Nfromurea+50%N from Poultry manure (N_3).

The reduction in soil pH with the application irrigation onthe basis of IW/CPE ratio might be due to dilution of salts and leaching of ions beyondtherootzone.Useoforganicmanuresviz.,poultrymanureandFYMhasalsobeenknown to help in reducing the soil pH to some extent by producing organic acids while theirdecompositionthatmayalsobethereasonofgreateravailabilityandmobilityofnutrientsmain lyof micronutrients. Thesefindings arecorroborated by(Jat*et al.*,2011).

OrganicCarbon

The observation regarding the organic carbon in gkg^{-1} presented in Table 2.Revealed that a slight improvement in organic carbon was obtained with increasing levelofmoistureregimeupto1.2IW/CPEration.It could be due to decomposition of organic residues and release of solubilized plant nutrients with maintaining the proper soil moisturelevels (Cauley *et al*., 2009).

Among the application of recommended doses of fertilizer and apply the organic manures along with inorganic fertilizer enhanced in build-up of organic carbon. Themaximumorganiccarbon(4.89gkg^{-1})wasobtainedwiththeapplicationN_3-50%RDF+50% N through poultry manure followed by N_2- 50%RDF+ 50%N through FYM. Theminimumwasrecordedwiththeapplicationrecommended dosesof fertilizer.

Table: 02 The variation of ph, electrical conductivity(EC) and organic carbon(OC) with respect of different treatments.

Treatment	pH	EC(dS m^{-1})	OC (g kg^{-1})
Moistureregimes			
0.6IW/CPEratio	8.20	0.32	4.22
0.8IW/CPEratio	8.23	0.31	4.43
1.0IW/CPEratio	8.20	0.31	4.45
1.2IW/CPEratio	8.20	0.31	4.68
SEm±	**0.17**	**0.004**	**0.37**
CDat 5%	**0.58**	**0.016**	**2.23**
Nitrogensources			
100%N from urea(N1)	8.05	0.31	4.44
50%N fromurea+50% N from FYM (N2)	8.05	0.31	4.68
50% N from urea + 50% N from Poultrymanure(N3)	8.00	0.32	4.89
SEm±	**0.17**	**0.005**	**0.46**
CDat 5%	**0.53**	**0.014**	**1.34**

AvailableNitrogen,PhosphorusPotassiumandZincof Soil as influenced by Different Moisture Regimes and Nitrogen Sourcesatharvestof thecrop

The data regarding the available N, P, K and Zn presented in Table 3.Evidentthat slight increment was received with the increasing soil moisture regime up to 1.2IW/CPEratio. Thelowervaluewas obtainedwith 0.6IW/CPE.

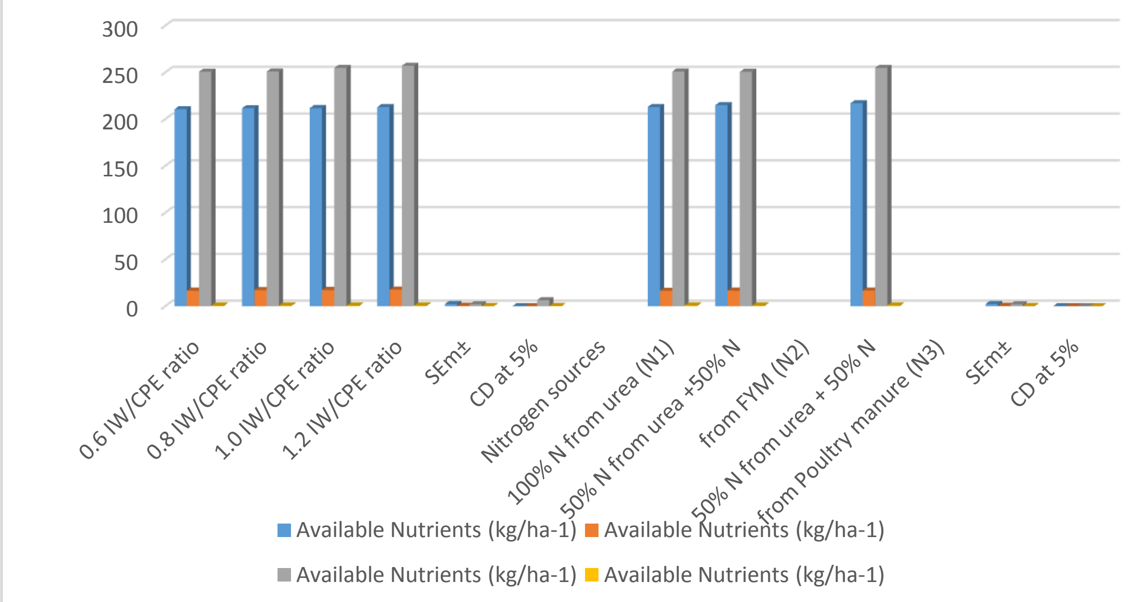
Inrespectofnitrogensourceswhichwereappliedas100%RDF,50%RDF+50%throughFYMand 50%throughRDF+50%PoultryManure.

ThemaximumnutrientsvizN, P, K and Zn were analyzed at after harvest of the crop with the application Nitrogenthrough50%RDF+50%Poultrymanure.Theminimumwasreceivedwiththeapplicationof100%RDFthroughinorganicfertilizer.Thebuild-upofavailablenutrientswith the application irrigation on the basis of IW/CPE ratio might be due to dilution ofsalts and leaching of ions beyond the root zone. Use of organic manures viz., poultrymanureandFYMhasreleasedtheavailabilityandmobilityofnutrientsafterthe decompositionmineralizationorganicssourcesofnutrientsmainlyofmicronutrients.Thesefindings arecorroborated by(Saha*et al.* 2019).

Table: 03Available N, P, K& Zn of Soil as influenced by Different Moisture Regimes and Nitrogen Sources

Treatment	**AvailableNutrients(kg/ha^{-1})**			
	Nitrogen (kgha^{1})	**Phosphorus (kgha^{1})**	**Potassium (kgha^{1})**	**Zinc (mgha^{1})**
Moistureregimes				
0.6IW/CPEratio	210.47	16.50	250.67	0.54
0.8IW/CPEratio	211.64	17.07	250.80	0.55
1.0IW/CPEratio	211.67	17.23	254.67	0.55
1.2IW/CPEratio	212.83	17.57	257.00	0.56
SEm±	**2.24**	**0.41**	**1.90**	**0.02**
CDat 5%	**NS**	**NS**	**6.41**	**0.08**
Nitrogensources				
100%N from urea(N1)	212.93	16.28	250.87	0.58
50%N from urea+50%N fromFYM (N2)	214.88	16.50	250.50	0.56
50%N from urea+50%N from Poultrymanure (N3)	216.93	16.65	254.77	0.64
SEm±	**2.29**	**0.28**	**2.01**	**0.029**
CDat 5%	**NS**	**NS**	**NS**	**NS**

fig. 2 Available N, P, K& Zn of Soil as influenced by Different Moisture Regimes and Nitrogen Sources



CONCLUSION

Moisture regimes 1.2 IW/CPE ratio was found best for viz., p^H , EC and organic carbon, Available Nitrogen, Phosphorus , Potassium &Zincandamong the Nitrogen level, application of 50%N from urea+50%N from Poultrymanure (N_3) was found suitable for soil fertility status followed by 50%N from urea+50%N fromFYM (N_2).

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