DISCOVERY

Effect of canal sediments and farmyard on Wheat (*Triticum aestivum* L.) yield and yield components at El Multaga Area, Northern State (Sudan)

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ABSTRACT

Study was conducted for two successive winter seasons; 2020/21 and 2021/22, at the Research Farm of the National Institute of Desert Studies (RFNIDS), New Hamdab Scheme, Northern State of Sudan. The objective was to study the effect of treatments interactions of canal sediments (20 and 40 ton ha^{-1}), application of farmyard manure fertilizer (0 and 10 ton ha^{-1}) on wheat (*Triticum aestivum* L.) growth and yield in the area. The experimental design was a complete randomizes block design (RCBD) with four replicates. The results showed that there were no significant differences ($P \leq 0.05$) on number of plants per meter square in both seasons. There were significant differences ($P \leq 0.01$) on plant height, number of tillers, number of seeds/spike, thousand seed weight, grain yield and harvest index in both seasons and highly significant differences ($P \leq 0.01$) according to the interactions effect of these factors on biological yield (Kg ha^{-1}) and straw yield in both seasons. The combination of application of (40 ton ha^{-1}) canal sediment and (10 ton ha^{-1}) farmyard manure showed the greatest averages of yield and yield components of wheat (*Triticum aestivum* L.) in both seasons at El-Multaga soil series -Northern State of Sudan.

Keywords: Canal sediment, Farmyard Manure, El Multaga Soil Series

1. INTRODUCTION

Wheat (*Triticum aestivum* L.) is mainly grown in the Sudan in irrigated scheme during October to December, recently horizontal expansion into latitudes lower than 15° N (Ageeb et al., 1996; Asfaw and Almahdy, 2011). Increasing wheat productivity is a national target in Sudan to fill the gap between wheat consumption and production (Mohamed et al., 2023). However, lack of yield stability over seasons and location has remained a great challenge to both research and production management (Babiker and Faki, 1994; Solomon, 2022). Wheat production under semi-arid conditions of Sudan is now a success. Grain

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yield of over five ton ha^{-1} were obtained when using much irrigation water either from river Nile or other source of water (Farah et al., 1994).

New Hamdab Scheme (Northern State of Sudan) suffers from sediment deposition in all irrigation canals which is caused problems in water flow to irrigated crops. Hi quantities of sediments are being extracted during cleaning of these canals contain high amounts of clay which are better for sandy soil reclamation (Mubarak et al., 2014). Ahmed, (2010) stated that application of manure in desert plain soil in the Northern Sudan significantly improved the soil chemical properties and minor increased in organic carbon, nitrogen; available phosphorus and potassium were observed. The soil pH was not affected by the source of organic manure.

Adam and Ali, (2004) studied the effect of farmyard manure (FYM), filter mud (FM) and bagasse (B) on yield of wheat at Khashm Elgirba soil series in Eastern Sudan. They are observed that the application of manures amendments resulted in high significant in increased wheat grain yield. Experiment of Awad-Elkarim, (2003) in high terrace soil of Hudeiba Research Farm studied the response of wheat to organic and inorganic fertilizers, they showed that organic manure significantly affected on wheat parameters such as plant height, length of spike number of seeds/head and grain yield. The aim of this study was to investigate the effect of canal sediments and farmyard manure application on wheat (*Triticum aestivum* L.) growth and yield in the area of El-Multaga- Northern state of Sudan.

2. MATERIAL AND METHODS

Field experiments were carried out during two consecutive winter seasons (2020/21 and 2021/22) at the National Institute of Desert Studies Research Farm, New Hamdab Scheme, Northern State of Sudan (latitude 17°55' N and longitude 31°10' E). The climatic zone of the area is described as desert, which is characterized by high temperature in summer, low temperature in winter and low rainfall (Habiballa and Ali, 2010). Land and water research center, (1999) analyzed the soil of study area classified as Vertic Haplocambids, fine loamy, mixed, supper active, hyperthermic (Table 1). The soil characterized by low chemical fertility and is deficient in macro elements such as nitrogen, phosphorus and organic carbon which are necessary for crops production. The physical and chemical properties of the soil are in (Table 1).

Table 1 Some soil properties of the experimental site

Soil properties	Soil depth (cm)				
	0 – 23	23 – 65	65 – 80	80 – 105	105 - 125
FS (%)	40	23	22	21	24
CS (%)	37	33	43	42	40
Silt (%)	15	25	11	19	8
Clay (%)	8	19	24	18	28
Texture	LS	SL	SL	SL	SCL
H (paste)	7.5	7.3	8.1	7.8	7.5
Ece	0.35	0.37	0.42	1.1	3.2
ESP	3.0	3.0	4.0	5.0	8.0
CaCO3 (%)	0.8	2.6	10.4	0.2	27.5
O.C (%)	0.052	0.066	0.078	0.061	0.052
C/N ratio	4	4	5	5	5

LS = loamy sand, SL = sandy loam, SCL= sandy clay loam

Treatments and Experimental Design

The treatments were arranged in completely randomized design with four replicates. The area of each sub- sub plot was 42 m^2 (6 × 7 m). The experimental units were two meters apart from each other. The experimental procedures were the same for both seasons. Treatments and their abbreviations are in (Table 2).

Cultural practices

Wheat variety Wadi Elneel was used in this study. Sowing was done manually by digging on 20th of November for both seasons, with seed rate of 120 kg ha^{-1}, at 0.2 m inter-row spacing. Nitrogen and Phosphorus were added as recommended by Agricultural Research Corporation (Sudan). The crop was harvested on 21st of March in both seasons.

Table 2 Treatments Application and their Abbreviations

Treatments	Abbreviation
20 ton ha^{-1} Canal Sediment +zero Faryard manure	CS_1FM_1
20 ton ha $^{-1}$ Canal Sediment +10 Faryard manure	CS_1FM_2
40 ton ha $^{-1}$ Canal Sediment +zero Faryard manure	CS_2FM_1
40 ton ha $^{-1}$ Canal Sediment +10 Faryard manure	CS_2FM_2

Collection of data

Plant samples were collected randomly from each experimental unit (sub- sub plot) and then growth and yield parameters were determined.

Number of plants/m^2 were counted for each season at 10 days after sowing in three different positions in each sub- sub plot using a steel frame of one meter square.

Ten whole plant samples were selected randomly from each plot at maturity stage, each season. Plant height as expressed in cm was measured from the tip of the spike to the soil surface and then the mean was calculated.

Using steel frame of one meter square, the number of spikes/m^2 was calculated at harvest time for each plot as an average number of three readings.

Number of tillers/m^2 was obtained by subtracting the number of plants/m^2 at 10 days after sowing from the number of spikes/m^2, each season.

Ten spikes samples were selected randomly from each plot at maturity stage and the spike length (cm) was measured and then the mean spike length was obtained.

Samples of ten spikes were selected randomly from each plot at maturity stage and seeds per spike were counted and then the mean number of seeds/spike was obtained.

A number of thousand seeds were picked randomly from each plot. The seeds were weighed and mean 1000-seeds weight (g) was obtained.

Plants of the net area of one meter square (using steel frame of one meter square) were cut at the soil surface at harvest time in three different positions in each plot, tied in bundles and left to dry by air. After drying, they were weighed, then the mean biological yield (kg ha-1) (dry matter plus grain) was determined.

The biological yield samples were manually threshed and the grain yield as expressed in kg ha^{-1} was obtained. Also, straw yield (kg ha^{-1}) was determined as follows:

$$Straw\ yield\ (kg\ ha^{-1}) = Biological\ yield\ (kg\ ha^{-1}) - Grain\ yield\ (kg\ ha^{-1})$$

Harvest index (%) was obtained using the following formula:

$$Harvestindex = \frac{Totalgrainyield\ (kgha^{-1})}{Totalbiologicalyield\ (kgha^{-1})} \times 100$$

Statistical analysis and interpretation of data

Statistical analysis was carried out using a computer software package (MSTAT). Significance of differences among the various characters under study was compared using Duncan's Multiple Range Test (DMRT).

3. RESULTS AND DISCUSSION

As in Table 3a and 3b the effect of treatments means on the examined parameters of wheat crop in both seasons. The results of the statistical analysis as in Table 3a and 3b indicated that farmyard manure and canal sediment had no significant effect on number of plant per meter square, significant effects ($P \leq 0.05$) on plant height, number of tillers/m^2, number of seeds/spike, 1000-seeds weight, harvest index and grain yield, highly significant differences ($P \leq 0.01$) on biological yield and straw yield for both seasons.

The results showed that the application of 10 ton ha^{-1} of farmyard manure with 40 ton ha^{-1} canal sediment resulted in the highest average values of all examined growth and yield attributes in both seasons. Several investigations from different parts of the world reported that addition of farmyard manure improved chemical properties of the soil and enhanced growth and yield of wheat, Awad-Elkarim and Younis, (2008) and Rasool et al., (2015), whom concluded that farmyard manure increased wheat growth and yield significantly.

Also, the results is in agreement with that of Ahmed, (2010) who stated that, farmyard manure improved the plant height, number of seeds per spike, number of spikes per square meter, number of tillers per square meter, 1000- seeds weight, straw yield, biological yield, grain yield and harvest index. As shown in results addition of canal sediment increased wheat yield and its components, this result confirms with that of Abdalla, (2017) who stated that addition of canal sediment increases yield and yield components of wheat in high terrace soil of Northern State of Sudan.

Table 3a Interaction effects of canal sediment and farmyard manure fertilization on wheat vegetative growth during tow winter seasons

Parameters	No. of plants/m^2		Plant height (cm)		No. of tillers/m^2		No. of seeds/spike	
Treatments	1st Season	2nd Season	1st Season	2nd Season	1st Season	2nd Season	1st Season	2nd Season
CS_1FM_1	182^b	201^c	67^c	73^c	54^c	59^d	32^c	32^c
CS_1FM_2	185^b	212^b	73^b	80^b	56c	63^c	33^c	34^b
CS_2FM_1	188^b	210^b	75^b	82^b	98^b	76^b	38^b	38^{ab}
CS_2FM_2	208^a	220^a	84^a	90^a	109^a	95^a	47^a	41^a
SE±	18.8	6.67	8.34	8.17	6.09	6.6	3.74	15.5
C.V (%)	16.3	9.2	20.6	18.2	13.6	17.3	17.1	16.9
Sig.	NS	NS	*	*	*	*	*	*

Means within columns followed by the same letter(s) are not significantly different at P<0.05 level according to Duncan's Multiple Range Test.
* And NS indicate significance at P≤0.05 and not significant, respectively.

Table 3b Interaction effects of canal sediment and farmyard manure fertilization on wheat vegetative growth during tow winter seasons

Parameters	1000-seeds weight (g)		Biological yield (Ton ha^{-1})		Grain yield (Ton ha^{-1})		Straw yield (Ton ha^{-1})		Harvest index (%)	
Treatments	1st Season	2nd Season	1st Season	2nd Season	1st Season	2nd Season	1st Season	2nd Season	1st Season	2nd Season
CS_1FM_1	30^b	33^c	7661^d	7225^d	2.300^d	2356^d	5219^c	4900^d	31^c	32^c
CS_1FM_2	35^a	35^b	9441^b	8322^c	3.115c	2980^c	6310^a	5445^b	33^b	34^b
CS_2FM_1	36^a	37^b	8854^c	8545^b	3536^b	3200^b	5100^c	5336^c	38a	36^{ab}
CS_2FM_2	37^a	39^a	9995^a	12300^a	3900^a	4699^a	5880^b	7789^a	40a	38^a
SE±	4.8	1.99	441	211	312	371	311	360	1.67	1.11
CV (%)	8.7	9.5	8.6	14.1	16.6	22.7	9.8	10.6	12.9	10.3
Sig.	*	*	**	**	*	*	**	**	*	*

Means within columns followed by the same letter(s) are not significantly different at P<0.05 level according to Duncan's Multiple Range Test.
* and ** indicate significance at P≤0.05 and 0.01, respectively.

4. CONCLUSION

The desert plain soils of the Northern State of Sudan are characterized by high amount of sand and low chemical soil fertility and mostly are deficient in nitrogen, phosphorus and organic carbon for optimum yield production of different cultivated crops amendment of canal sediment and farmyard manure can be used. Addition of farmyard manure and canal sediment, are a good solution for poor and infertile sandy soil of the study area and enhanced wheat growth and yield.

Informed consent

Not applicable.

Ethical approval

The ethical guidelines for plants & plant materials are followed in the study.

Conflicts of interests

The authors declare that there are no conflicts of interests.

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The study has not received any external funding.

Data and materials availability

All data associated with this study are present in the paper.

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