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Efficiently of Yield based Tolerance Indices on two Cultivars of Wheat (*Triticum aestivum L*) in High Terrace soil of Sudan

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Original Research Article

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Abstract: The experiment was conducted during two consecutive seasons of 2013/2014 and 2014/2015 at high terrace soil, Dongola Rsearch Station Farm. Dongola, Northern State, Sudan. The objective of this study was to determine the efficiency of yield based tolerance indices on two cultivars of wheat in high terrace soil of Sudan. Experimental design used was randomized complete block in split-split plot arrangement with three replications. The main plot was consisted of three water intervals (7, 14 and 21days) and the subplots were consisted of two varieties (Wadi- El neil and ELneileen), while Sub-sub plot consisted of four nitrogen levels (zero, 43, 86 and 129 kg N/ha). Several yield based drought tolerance indices including stress tolerance indices (STI), Stress sustainability indices (SSI) and tolerance indices (TOI) were calculated. The results showed that there were no significant differences between nitrogen levels, wheat varieties and their interactions on tolerant indices and stress stability indices in both seasons. The variety Wadi ELneil performed better in most of yield and yield based tolerance indices than Elneileen. The analysis of variance revealed that there were highly significant differences among nitrogen levels on stress tolerance index in both seasons. The application of 129 kg N/ha gave greater stress tolerance index in both seasons .There were significant differences among wheat varieties in stress tolerance index in the second season only and no differences among interaction of nitrogen and cultivars. The results indicated that nitrogen dose of 129 kg/ha increased significantly yield of wheat, but in some economically cause the use of 86 kg/ha is more suitable. Irrigation interval at seven days gave greater yield in comparison of irrigation intervals after 14 and 21 days. Nitrogen use efficiency is more reliable character in the use of fertilizer doses in high terraces soil in the Northern State of Sudan.
Keywords: yield, tolerant indices, wheat, high terrace, Sudan.

INTRODUCTION

In Sudan, wheat is exclusively produced under irrigation during the period from November to March. This period is shorter and has relatively higher temperature than those of traditional wheat producing regions of the world. The Northern region (Northern and Nile River States) of the country having a longer and cooler season constitutes the most suitable ecological environment for wheat production [1]. Indicated the main problems of irrigation in Northern Sudan were emanating from unavailability of water. Increasing the yield of wheat in most areas require more water for wheat sowing. Drought stress not only affects plant growth and development but also ultimately productivity in almost all the cereals, but it is one of the most serious threats to world agriculture [2]. On the bases of climatic conditions Dongla in Sudan, located in arid lands and this land is mainly dependent on scarcity and erratic water shortage.

Results indicated that the irrigation, nitrogen and cultivars were affected significantly on yield. Increase nitrogen levels and irrigation water coincided to improve chlorophyll content and other nutrients in leaves and seed [3]. For water stress, severity, duration and timing of stress as well as response of plants after stress removal and interaction between stress and other factors are extremely important [4].

Nitrogen use efficiently (NUE) of wheat decreased with increasing nitrogen fertilizer levels [5]. Availability of N to the plants during growing season and weather condition specially rain fall are affecting NUE by the crop [6, 7]. Many researchers in different studies reported that application of nitrogen of 75 and 150 kgN/ha [8], 180kgN/ha [9], and 240 kgN/ha [10], in wheat increasing grain yield and its components. Based on the results, farmers should be advised that to use of

the large amounts of nitrogen increases production costs and reduce benefits.

Drought being one of the main limiting factors of wheat production should be highly preferred in the future wheat improvement. This article is aimed to study the efficiently of yield based tolerance indices on two cultivars of wheat (*Triticum aestivum l*) in high terrace soil of Sudan.

MATERIALS AND METHODS

Two field experiments were conducted during season 2013/2014 and 2014/2015 at Dongola research station farm in Northern state, Sudan (22 and 16°N; 32 and 25°E). The experimental area was tilled adequately to prepare a suitable seedbed. The implements used included a chisel plough (Cross plow) to break and loosen the soil and a leveler (scraper) to level the experimental area for the easy movement and uniform distribution of irrigation water. The field was then divided into three blocks (replication) each contained 24 equal plots of 2½m × 4m size. Plant was done on 1 December for both seasons. In rows 20cm apart at the seed rate of 90kg/h or 48.6gm/plot of 11 rows (3m long). Weed control was done by hand weeding ten days after sowing and then as needed throughout the growing season.

The lied out of Experiment design was a randomized complete block in split – split plots arrangement with three replications. The main plot contains irrigation three irrigation intervals (W1: 7 days, W2: 14 days and W3: 21 days) and varieties; two wheat varieties (V1: Wadi Elneil and V2: ELneileen) in sub plot and nitrogen levels; four nitrogen levels (N0: zero, N1: 43kgN/ha, N2: 86kg N/ha and N3: 129 N kg/ha) as sub subplot.

Grain yield (t/ha): When signs of maturity were clear on the plant (complete yellowing of leaves and spikes) one meter square of the five central rows in each plot was harvested for yield. Grain yield per plot was converted to grain yield (t/ha).

Biological yield (t/ha): From the middle rows of each plot, plants in one meter square area were cut at soil surface and dried then weighted and recorded to t/ha.

Drought Tolerance Indices

1. Tolerant Indices (TOI) = grain yield under low irrigation/ grain yield under normal water (yl/yh)

2. Stress susceptibility indices (SSI) =

$$\frac{1-Ysi/Ypi}{1-Ys/Yp}$$

Ysi = grain yield of each genotype under stress
Ypi = grain yield of each genotype under optimal condition
Ys = mean of grain yield under stress
YP = mean of grain yield under optimal condition

3. Stress tolerance index (STI) =

$$\frac{Ysi.Ypi}{Y^2P}$$

Where:
YSi = grain yield of each genotype under stress
YPi = grain yield of each genotype under optimal condition
Y^2P = square of mean grain yield in all genotypes under optimal conditions.

Nitrogen use efficiency (NUE) = Yg (Kg/ha) / Actual amount of nitrogen added.

Statistical Analysis

The data collected were subjected to analysis of variance (ANOVA) appropriate for randomized complete block design [11]. Duncan's Multiple Range Test (DMRT) was applied for the separation of treatment means. All statistical analyses were performed using M-STAT-C program computer package.

RESULTS AND DISCUSSION

Grain yield (t/ha): The analysis of variance indicated that nitrogen had highly significant effect (P= 0.01) on grain yield of wheat in both seasons (Table 1). The application of 129 kg N/ha gave 40% and 44% greater yield over control in the first and second season, respectively, on the other hand, there were no significant differences between the application of 43 kg N/ha and control in the second seasons (Table 1).There were highly significant differences (P= 0.01) between irrigation intervals on yield of wheat in both seasons (Table 1).Irrigation intervals at 7 days gave 50% greater yield in compare to irrigation interval at 21 days in both seasons (Table 1).There were highly significant differences (P = 0.01) among wheat varieties in yield in the second seasons only (Table 1).In the second seasons wadi El Neil gave 21% greater yield than ELNeileen (Table 1). Interaction of nitrogen X irrigation had significant differences (P = 0.05) in the second season, while interaction of nitrogen X varieties had significant effect on yield of wheat in the first season (Table 1). Wheat varieties differ in grain yield in the second season only. Similar results observed by [12,13 And 14] they showed that grain yield and its components were significantly among cultivars.

Biological yield (t/ha): Statistical analysis showed that nitrogen had highly significant Effect (P = 0.01) on biological yield in both seasons (Table 2).Application of 129 kg N/ha gave 28% and 18% greater biological yield over control in the first and second season, respectively (Table 2). There were significant differences (P = 0.01) in biological yield between irrigation intervals in both seasons (Table 2).There were highly significant differences (P = 0.01) among wheat varieties in biological yield in the first season only (Table 2). In the first season Elneileen had

greater biological yield than Wadi Elneil (10% increase) (Table 2).

Irrigation interval at 7 days gave 25% and 22% greater biological weight in compare to irrigation interval at 21 days in the first and second season, respectively; on the other hand, there were no significant differences between irrigation interval at 7 and 14 days in biological weight in the second season (Table 2). Interaction of irrigation intervals X varieties had highly significant effect on biological yield in the second season only (Table 2). In addition, Interaction of nitrogen X irrigation X varieties had (P= 0.01) highly significant differences in biological yield in the first season but there were no significant differences in the second season, (Table 2).

In this study, nitrogen fertilizer had highly significant effect on yield of wheat in both seasons. Application of 129 kg N/ha gave greater yield in both seasons. This result was similar to that reported by [15 ,16] they showed that yield increase significantly with increase of nitrogen rate.

Drought tolerance indices (DTI); results in form of tolerance indices (TOI), stress sustainability indices (SSI) and stress tolerance index(STI) were presented in Table 3&4 for seasons 2013/14-2014/15. The analysis of variance showed that there were no significant differences between nitrogen levels on tolerant indices and stress stability indices in both seasons (Table 3&4). The statistical analysis also showed no significant differences among wheat varieties on tolerant indices and stress stability index in both seasons (Table3&4). There were no significant differences between treatment interactions on tolerant index and stress stability in both seasons (Table 3&4).

The analysis of variance revealed that there were highly significant differences (P=0.01) between nitrogen levels on stress tolerance index in both seasons (Table3&4). The application of 129 kg N/ha gave greater stress tolerance index in both seasons (Table 3&4).There were significant differences among wheat varieties in stress tolerance index in the second season only (Table3).Interaction of nitrogen and varieties showed no significant differences in stress tolerance index in both seasons (Table3&4) [17]. Reported that SSI, TOI and STI with variable concordance values were found to be inaccurate indices to identified tolerant genotypes in durum wheat.

NUE parameters are high under low nitrogen levels and decrease with increasing nitrogen level Fig 1. Decreased NUE at high nitrogen is attributed to higher losses because the plant is unable to absorb all of nitrogen applied [18].

Table-1: Effect of nitrogen on yield of two wheat cultivars under post anthesis of water stress during season 2013-14

	First season						Second season				
		No	N1	N2	N3	X	N0	N1	N27	N3	X
W1	V1	3.3hi	4.4cd	4.9bc	5.7a	4.6a	4.3cd	4.5cd	5.4a	5.7a	5.0a
	V2	3.7fg	4.7bc	4.5cd	5.2ab	4.5a	2.9ij	3.4gh	3.9de	5.2ab	3.8b
X		3.5de	4.6b	4.7b	5.4a	4.5a	3.5cd	3.9c	4.6b	5.5a	4.4a
W2	V1	3.1ij	3.5gh	4.2de	5.0bc	4.0ab	3.5gh	3.6fg	4.2cd	4.6bc	3.9b
	V2	2.9kl	3.5gh	3.8ef	4.2de	3.6bc	2.9ij	3.2hi	3.7ef	4.4cd	3.6bc
X		3.0fg	3.5de	4.1c	4.6b	3.8b	3.2de	3.4de	3.9c	4.5b	3.8b
W3	V1	2.5mn	2.8kl	3.5gh	4.1de	3.2cd	2.7kl	3.1hi	3.3gh	3.6fg	3.2c
	V2	2.3n	2.7lm	3.0jk	3.4hi	2.8d	2.3m	2.5lm	2.8jk	3.2ij	2.7d
X1		2.4h	2.6de	2.9cd	3.2bc	3.0c	2.5g	2.7de	2.8de	2.9cd	2.9c
X2		2.9d	3.6c	4.0b	4.2a		3.1c	3.4c	3.9b	4.5a	
G.M.V1	3.9a						4.0a				
G.M.V2	3.6a						3.4b				
CV%	9.04						3.33				

Key: N: Fertilizer levels (N0: zero, N1: 43kgN/ha, N2: 86kg N/ha and N3: 129 N kg/ha), W: irrigation intervals (W1: 7 days, W2: 14 days and W3: 21 days, V: wheat varieties (V1: Wadi El Neil and V2: EL Neileen).
Means within column flowed by the same letter(s) were not significantly different according to Duncan's Multiple Range test at 5% level.

Table-2: Effect of nitrogen on biological yield of two wheat cultivars under post anthesis of water stress during season 2013-14

	First season						Second season				
		No	N1	N2	N3	X	N0	N1	N27	N3	X
W1	V1	10.6jk	11.3hi	13.0cd	14.4ab	12.3b	11.8ef	12.3cd	13.1ab	14.0a	12.8a
	V2	11.9fg	13.1cd	14.3ab	14.8a	13.5a	11.6fg	13.2ab	13.9ab	14.2a	13.2a
X		11.2de	12.2c	13.7b	14.6a	12.9a	11.7de	12.7bc	13.5a	14.2a	13.0a
W2	V1	10.1ki	10.3ki	11.5gh	12.9de	11.2c	11.2hi	11.6fg	12.1de	12.8bc	11.9b
	V2	11.4hi	12.2ef	12.9de	13.7bc	12.6c	11.5fg	12.6cd	13.3ab	14.0a	12.8a
X		10.7e	11.2de	12.2c	13.3b	11.8b	11.3ef	12.1cd	12.7bc	13.4ab	12.4a
W3	V1	8.8n	9.8lm	10.2kl	10.5ij	9.9d	10.4kl	10.6jk	11.0ij	110.7ef	10.9c
	V2	9.2mn	9.8lm	11.4hi	12.6de	10.7cd	9.5m	10.0lm	10.6jk	11.2jh	10.3d
X1		9.0g	9.8f	10.8e	11.7cd	10.3c	9.9h	10.3gh	10.8fg	11.5de	10.6b
X2		10.3d	11.1c	12.2b	13.2a		11.0d	11.7c	12.3b	12.9a	
G.M.V1	11.1b						11.1b				
G.M.V2	12.3a						12.3a				
CV%	3.71						4.89				

Key: N: Fertilizer levels (N0: zero, N1: 43kgN/ha, N2: 86kg N/ha and N3: 129 N kg/ha), W: irrigation intervals (W1: 7 days, W2: 14 days and W3: 21 days, V: wheat varieties (V1: Wadi El Neil and V2: EL Neileen).

Means within column flowed by the same letter(s) were not significantly different according to Duncan's Multiple Range test at 5% level.

Means within column flowed by the same letter(s) were not significantly different according to Duncan's Multiple Range test at 5% level.

Table-3: Efficiency of yield based tolerance indices of two cultivars of wheat in high terrace soil of Sudan season 2013/14

	Tolerant indices(TOI)					Stress stability indices(SSI)					Stress tolerance indices(STI)				
	N0	N1	N2	N3	X	N0	N1	N2	N3	X	N0	N1	N2	N3	X
V1	0.70 a	0.70 a	0.70 a	0.70 a	0.67 a	0.92 a	0.92 a	0.92 a	0.92 a	0.97 a	0.92 a	0.92 a	0.92 a	0.92 a	0.92 a
V2	0.64 a	0.64 a	0.64 a	0.64 a	0.65 a	1.00 a	1.00 a	1.00 a	1.00 a	1.00 a	1.00 a	1.00 a	1.00 a	1.00 a	0.92 a
X	0.67 a	0.67 a	0.67 a	0.67 a		0.96 a	0.96 a	0.96 a	0.96 a		0.96 a	0.96 a	0.96 a	0.96 a	
CV %															

Key: N: Fertilizer levels (N0: zero, N1: 43kgN/ha, N2: 86kg N/ha and N3: 129 N kg/ha), W: irrigation intervals (W1: 7 days, W2: 14 days and W3: 21 days, V: wheat varieties (V1: Wadi El Neil and V2: EL Neileen).

Table-4: Efficiency of yield based tolerance indices of two cultivars of wheat in high terrace soil of Sudan season 2014/15

	Tolerant Indices(TOI)					Stress Stability Indices (SSI)					Stress Tolerance Indices(STI)				
	N0	N1	N2	N3	X	N0	N1	N2	N3	X	N0	N1	N2	N3	X
V1	0.63 a	0.63 a	0.63 a	0.63 a	0.64 a	1.10 a	1.10 a	1.10 a	1.10 a	0.91 a	2.64cd	2.64cd	2.64cd	2.64cd	2.06d
V2	0.81 a	0.81 a	0.81 a	0.81 a	0.72 a	1.02 a	1.02 a	1.02 a	1.02 a	0.94 a	1.48f	1.48f	1.48f	1.48f	2.56 c
X	0.72 a	0.72 a	0.72 a	0.72 a		1.06 a	1.06 a	1.06 a	1.06 a		2.06d	2.06d	2.06d	2.06d	
CV %															

Key: N: Fertilizer levels (N0: zero, N1: 43kgN/ha, N2: 86kg N/ha and N3: 129 N kg/ha), W: irrigation intervals (W1: 7 days, W2: 14 days and W3: 21 days, V: wheat varieties (V1: Wadi El Neil and V2: EL Neileen).

Means within column flowed by the same letter(s) were not significantly different according to Duncan's Multiple Range test at 5% level.

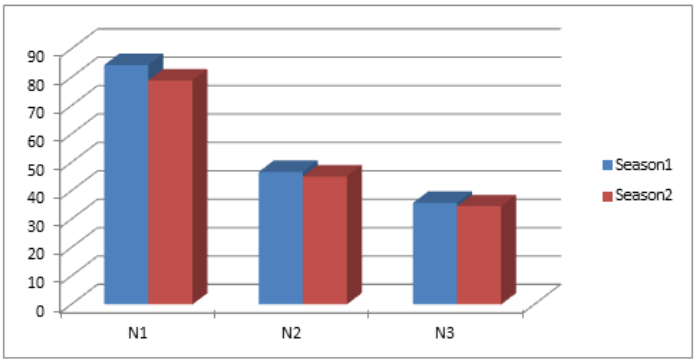

Fig-1: Nitrogen Use Efficiency (NUE) of wheat

REFERENCES

1. Elsir A and Abedalla I. Monitoring and evaluating of farmer's, Northern Sudan. Annual national meeting, ARG, Wad Medani, Sudan. 2003.
2. Hamayun M, Khan SA, Khan AL, Shinwari ZK, Hussain J, Sohn EY, Kang SM, Kim YH, Khan MA, Lee IJ. Effect of salt stress on growth attributes and endogenous growth hormones of soybean cultivar Hwangkeumkong. Pak. J. Bot. 2010 Oct 1;42(5):3103-12.
3. Pakhahan MM. Effects of levels of nitrogen, irrigation and wheat cultivars on growth and yield and chemical compostion of wheat (*Triticum aestivum L*). Zanco Journal. 2010; 22(4):118-138.
4. Estrada-Campuzano G, Miralles DJ, Slafer GA. Genotypic variability and response to water stress of pre-and post-anthesis phases in triticale. European Journal of Agronomy. 2008 Apr 1;28(3):171-7.
5. Li L, HongJP, Wang HT, Xiu YH, and Zhang L. Effects of watering and nitrogen fertilizers on growth, grain yield, water and nitrogen use efficiency of winter wheat. Chines J. of Applied Ecology. 2013; 24:1367-1373.
6. Hatfield JL, Prueger JH. Nitrogen over-use, under-use, and efficiency. InProceedings of the 4th International Crop Science Congress 2004 Sep (Vol. 26).
7. Bertic B, Loncaric Z, Vukadinovic V, Vukobratovic Z, Vukadinovic V. Winter wheat yield responses to mineral fertilization. Cereal Research Communications. 2007 Apr 25;35(2):245-8.
8. Mandic V, Krnjaja V, Tomic Z, Bijelic Z, Simic A, Ruzic Muslic D, Gogic M. Nitrogen fertilizer influence on wheat yield and use efficiency under different environmental conditions. Chilean journal of agricultural research. 2015 Mar;75(1):92-7.
9. Noureldin NA, Saudy HS, Ashmawy F, Saed HM. Grain yield response index of bread wheat cultivars as influenced by nitrogen levels. Annals of Agricultural Sciences. 2013 Dec 1;58(2):147-52.
10. Abedi T, Alemzadeh A, Kazemeini SA. Wheat yield and grain protein response to nitrogen amount and timing. Australian Journal of Crop Science. 2011 Mar;5(3):330.
11. Gomez KA, Gomez KA, Gomez AA. Statistical procedures for agricultural research. John Wiley & Sons; 1984 Feb 17.
12. Carr PM, Horsley RD, Poland WW. Tillage and seeding rate effects on wheat cultivars. Crop science. 2003 Jan 1;43(1):210-8.
13. Khan N, Qasim M. Genotypic variation in wheat genotypes under agro-climatic condition ofKaghan valley [Pakistan]. Asian Journal of Plant Sciences (Pakistan). 2004.
14. Rashid MH, Samanta SC, Biswas P, Mannan MA, Zaman AK. Performance of thirty wheat genotypes under late sown conditions in southern region of Bangladesh. Asian J. Plant Sci. 2004;3(3):286-9.
15. Devi KN, Singh MS, Singh NG, Athokpam HS. Effect of integrated nutrient management on growth and yield of wheat (Triticum aestivum L). Journal of Crop and Weed. 2011;7(2):23-7.
16. Singh D, Singh M, Sharma KC. Correlation and Path-Coefficient Analysis among Flag Leaf-Area, Yield and Yield Attributes in Wheat (Triticum aestivum L). Cereal Research Communications. 1979 Jan 1:145-52.
17. Mohammadi R. Efficiency of yield-based drought tolerance indices to identify tolerant genotypes in durum wheat. Euphytica. 2016 Sep 1;211(1):71-89.
18. Giambalvo D, Ruisi P, Miceli GD, Frenda AS, Amato G. Nitrogen use efficiency and nitrogen fertilizer recovery of durum wheat genotypes as affected by inter specific competition. 2009.