



INFLUENCE OF IRRIGATION, NITROGEN AND WEEDING ON YIELD COMPONENTS AND STRAW YIELD OF TRITICALE

Yusuf, N. B., Fagam, A. S., Shuaibu, Y. M. and Kawure, S.

Department of Crop Production, Faculty of Agriculture and Agricultural Technology,
Abubakar Tafawa Balewa University, Bauchi

Corresponding Author Email: nurubli177@gmail.com

ABSTRACT

Field experiment was conducted during 2014, 2015 and 2016 dry seasons to study the influence of irrigation, nitrogen and weeding on yield components and straw yield of triticale at Saulawa (Latitude 12°40'11"N and Longitude 7°48'19"E) in Katsina State. The treatments consisted of three irrigation intervals (5, 7 and 9 days), four nitrogen levels (0, 60, 90 and 120 kg N ha⁻¹) and three weeding regimes (No weeding, one weeding at 20 days after sowing (DAS) and two weeding at 20 and 40 DAS), these were arranged in a split plot design with three replications. Irrigation intervals were allocated to main plot while factorial combinations of nitrogen levels and weeding regimes were allocated to the sub-plots. Data were collected on number of spikelets/spike, number of grain/spike, weight of grain/spike and straw yield. All data collected were subjected to analysis of variance and Duncan's Multiple Range Test was adopted in separating means. The results of the experiment revealed a significant ($P \leq 0.05$) difference among the treatments used throughout the study period. The result further indicated that yield components and straw yield of triticale were significantly ($P \leq 0.05$) higher at 5 days irrigation interval with the application of 120 kg N ha⁻¹ and twice weeding at 20 and 40 DAS. Irrigation interval beyond 5 days significantly ($P \leq 0.05$) decreased triticale straw yield. Application of 120 kg N ha⁻¹ significantly ($P \leq 0.05$) increased straw yield and most of the yield characters. Similarly, two weeding at 20 and 40 DAS significantly ($P \leq 0.05$) increased straw yield of the crop. Based on the result of this findings, 5 days irrigation interval, 120 kg N ha⁻¹ and two weeding at 20 and 40 DAS were recommended for higher grain and straw yield in the study area.

Key words: Spikelet, Straw, Irrigation, Yield components

INTRODUCTION

Triticale (*Triticale tricoecale* wittmack) is a hybrid cereal crop developed by crossing wheat (*Triticum turgidum* or *Triticale aestivum*) and rye (*Secale cereale*) pollen. The objective of making wheat/rye crosses was to capture the best traits of each species. Wheat yields and grain qualities are better than rye. But rye has better disease resistance and better tolerance to environmental stress. The area under cultivation of triticale (both winter and spring cultivars) in the world increased from 2.49 million ha. in 2000 to 3.81 million ha in 2019 growing at an average annual rate of 2.47%. The world production of triticale was however, 14,060,433 t ha⁻¹ and yield of 36,927 kg ha⁻¹. Triticale is a newly introduced crop in Nigeria and grown under irrigation condition. The primary producers of triticale are however, Poland, Germany, Belarus, France and Russia (FAO 2019).

Irrigation water is in short supply and thus it is more important that water must be judiciously used in a way that crop growth does not suffer (Aremu and Chari, 1987). Nitrogen is an essential nutrient, and often the most yield limiting for cereal production. High cost, scarcity and poor distribution of fertilizer has however, made the commodity not always easily available to resource poor farmers. Traditional manual weeding is the most popular method of



weed control in Nigeria. This is however, time consuming, tedious and labour intensive, strenuous and generally expensive as such beyond farmers (Joshua and Gworgwor, 2000). This study is therefore carried out to assess the influence of irrigation interval, nitrogen fertilizer and weeding frequency on growth and yield of triticale.

MATERIALS AND METHODS

The experiment was conducted during 2014, 2015 and 2016 dry seasons under irrigation from December- March at the Saulawa Irrigation Site in Bindawa Local Government of Katsina State, located at Latitude $12^{\circ} 40' N$ and longitude $7^{\circ} 48' E$ at an altitude of 465m above sea level (Google Earth, 2017) in the Sudan savanna agro-ecological zone of Nigeria. The area has a long dry season that is characterized by cool dry air during harmattan from November to February and hot dry air during hot season from March to May. Rainfall in the area lasts for 4-5 months in a year, starting from late May or early June to September/October. The average annual rainfall in the area is reported to be 600 mm. Potential evapo-transpiration is about 1700-1800 mm per annum and the mean annual temperature ranges from $14^{\circ}C$ to $38^{\circ}C$ (Google Earth, 2017).

The treatments consisted of three irrigation intervals (5, 7 and 9 days), four nitrogen levels (0, 60, 90 and 120 kg N ha^{-1}) and three weeding regimes (No weeding, one hoe weeding at 20 days after sowing [DAS] and two hoe weeding at 20 and 40 DAS). The experiment was laid out in split- plot design with three replications. Irrigation was allocated to main plot while factorial combinations of nitrogen levels and weeding regimes were allocated in the sub-plots. The land was cleared manually and then ploughed, harrowed, leveled and made into appropriate plots. Basins were constructed manually and the borders were raised to 10 cm height to minimize seepage. Plots were marked out with 1.0 m irrigation channels. Gross plot size was $6 \times 1.38 \text{ m}$ (9.28 m^2) and net plot size was $5 \times 0.92 \text{ m}$ (4.60 m^2). Distance of 0.5 m between subplots and 2 m between main plots and between blocks was maintained throughout the trial period.

In each season, spring triticale seeds variety 'Abase' obtained from the Department of Agronomy, Bayero University, Kano were sown on 15th November each year by drilling at 2 cm depth at the seed rate of 120 kg ha^{-1} . A spacing of 23 cm inter row and 5 cm intra row was maintained. There were six rows in each sub-plot. Irrigation was carried out by surface flooding in which each plot is filled to capacity using channels from tube- well. For the first two weeks after sowing, irrigation was carried out at five days interval, thereafter the irrigation treatment was imposed accordingly. Nitrogen was applied in form of NPK 15:15:15 and urea. Half of the N in form of NPK was applied at sowing while the remaining half was applied at 40 DAS using urea 46% N. data were collected on number of spikelets/spike, number of grain/spike, weight of grain/spike and straw yield. All data collected were subjected to analysis of variance (ANOVA) using SPSS (2.0) and Duncan's Multiple Range Test (DMRT) was adopted in separating the means.

RESULTS AND DISCUSSION

Number of Spikelet Spike⁻¹

Table 1 shows the result of the effect of irrigation intervals, nitrogen levels and weeding regimes on number of spikelets per spike in 2014, 2015 and 2016 dry seasons. Number of spikelets spike⁻¹ responded significantly ($P \leq 0.05$) to irrigation levels in all the three dry seasons. Irrigation at 5 and 7 days interval recorded significantly ($P \leq 0.01$) similar number of spikelets per spike and the least was obtained at 9 days irrigation interval. The effect of nitrogen levels on number of spikelets per spike was significant. Application of 120 and 90 kg N ha^{-1} recorded



statistically similar number of spikelets per spike. The response of number of spikelets per spike to weeding regimes was significant in all the dry seasons. Two weeding produced more number of spikelets per spike.

Result of the interaction of irrigation intervals and weeding regimes on number of spikelets spike⁻¹ of triticale in 2014 (Table 2) revealed that weeding at 20 and 40 DAS with irrigation at 5 and 7 days interval significantly ($P \leq 0.05$) produced higher number of spikelets than the other treatments considered.

Table 1: Response of Triticale to Irrigation intervals, Nitrogen levels and Weeding regimes on Number of Spikelets Spike⁻¹

		Number of Spikelets Spike ⁻¹		
Treatment		2014	2015	2016
Irrigation intervals (days)				
5		22.20a	24.01a	20.79a
7		21.36ab	23.31a	17.85b
9		20.59b	21.95b	17.40b
Level of Significance		**	**	**
SE \pm		0.262	0.321	0.323
Nitrogen levels (kg ha ⁻¹)				
0		19.81c	21.49c	17.51c
60		21.03b	22.84bc	18.35bc
90		21.84ab	23.55ab	19.01ab
120		22.86a	24.48a	19.85a
Level of Significance		**	**	**
SE \pm		0.301	0.372	0.372
Weeding regimes (DAS)				
No weeding		17.80c	20.18c	15.64c
20		21.84b	23.41b	18.67b
20 & 40		24.51a	25.69a	21.73a
Level of Significance		**	**	**
SE \pm		0.262	0.323	0.323
Interactions				
I * N		NS	NS	NS
I * W		**	NS	NS
N * W		NS	NS	NS
I * N * W		NS	NS	NS

Means in a column followed by similar letter (s) are not statistically different by DMRT, NS = Not significant, ** = Significant at 1% level of probability



Table 2: Interaction of Weeding Regime and Irrigation Interval on Number of Spikelets Spike⁻¹ 2014 Dry Season.

Treatment	Irrigation intervals (days)		
	5	7	9
Weeding regimes (DAS)			
No weeding	19.61d	17.16e	16.61e
20	22.10bc	22.00bc	21.40cd
20 & 40	24.86a	24.90a	23.76ab
SE \pm		0.454	

Means in a column followed by similar letter (s) are not statistically different by DMRT

Number of Grains Spike⁻¹

Results of number of grain per spike as affected by irrigation intervals, nitrogen levels and weeding regimes is presented in Table 3. The result indicated that, irrigation interval significantly ($P \leq 0.05$) affected the number of grains spike⁻¹. Irrigation at 5 days interval produced significantly ($P \leq 0.05$) higher number of grains spike⁻¹ than the other irrigation regime considered throughout the study period. The result further showed that, number of grains spike⁻¹ generally increased with increase in nitrogen fertilizer. Application of 90 and 120 kg N ha⁻¹ produced statistically ($P \leq 0.05$) similar number of grains spike⁻¹ in 2014 and 2015 dry seasons but significantly ($P \leq 0.05$) better than the other treatments used. Weeding interval on the other hand, the result revealed that two weeding at 20 and 40 DAS produced the highest number of grains spike⁻¹.

The result of the interaction of irrigation intervals and weeding regimes in 2016 dry season (Table 4) revealed that, irrigation at 5 days interval to triticale weeded at 20 and 40 DAS produced significantly ($P \leq 0.05$) higher number of grain than the other treatment combinations used.



Table 3: Response of Triticale to Irrigation interval, Nitrogen level and Weeding regimes on Number of Grains Spike⁻¹

Treatment	Number of Grains Spike ⁻¹		
	2014	2015	2016
Irrigation intervals (days)			
5	26.88a	41.51a	38.63a
7	24.40b	40.47ab	36.80ab
9	24.10c	38.28b	34.91b
Level of Significance	**	**	**
SE \pm	0.662	0.693	0.581
Nitrogen levels (kg ha ⁻¹)			
0	21.26c	36.67c	32.42c
60	24.40b	39.26bc	35.32b
90	24.66ab	41.07ab	37.73b
120	28.16a	43.35a	41.66a
Level of Significance	**	**	**
SE \pm	0.760	0.791	0.672
Weeding regimes (DAS)			
No weeding	16.92c	33.09c	27.06c
20	25.59b	39.57b	36.11b
20 & 40	32.84a	47.60a	47.17a
Level of Significance	**	**	**
SE \pm	0.663	0.690	0.580
Interaction			
I * N	NS	NS	NS
I * W	NS	NS	*
N * W	NS	NS	NS
I * N * W	NS	NS	NS

Means in a column followed by similar letter (s) are not statistically different by DMRT, NS = Not significant, ** = Significant at 1% level of probability

Table 4: Interaction of Irrigation Interval and Weeding Regimes on Number of Grain spike⁻¹ in 2016 Dry Season

Treatment	Irrigation interval (days)		
	5	7	9
Weeding regimes (days)			
No weeding	28.52d	27.57d	25.08d
20	36.80c	35.47c	36.07c
20 & 40	50.55a	47.36ab	43.58b
SE \pm		0.999	

Means in a column followed by similar letter (s) are not statistically different by DMRT

Weight of Grains Spike⁻¹

The result of response of weight of grain spike⁻¹ is shown in Table 5. The result revealed a significant ($P \leq 0.05$) difference among the treatments used throughout the study period. The result further indicated that, irrigation at 5 days interval produced the heaviest grain than the

other intervals considered. The result also showed that, nitrogen had significant ($P \leq 0.05$) effect on weight of grain spike⁻¹ and the heaviest grain spike⁻¹ was recorded at 120 kg N ha⁻¹ which was statistically ($P \leq 0.05$) similar with 90 kg N ha⁻¹ except in 2016 where it was at far with 60 and 90 kg N ha⁻¹. The effect of weeding regimes on weight of grain spike⁻¹ on the other hand, the result showed that, two weeding produced the heaviest grain, followed by one weeding.

Table 5: Response of Triticale to Irrigation intervals, Nitrogen levels and Weeding regimes on Weight of Grain Spike⁻¹ (g)

Treatments	Weight of Grain Spike ⁻¹ (g)		
	2014	2015	2016
Irrigation intervals (days)			
5	4.57a	5.51a	8.06a
7	3.29b	2.91b	4.64b
9	2.69c	2.13c	1.93c
Level of Significance	**	**	**
SE \pm	0.152	0.092	0.233
Nitrogen levels (kg ha ⁻¹)			
0	2.30c	3.14c	4.13b
60	3.24bc	3.37bc	4.61b
90	3.73ab	3.58ab	5.13ab
120	4.10a	3.98a	5.63a
Level of Significance	**	**	**
SE \pm	0.183	0.112	0.272
Weeding regime (DAS)			
0	2.37c	2.79c	3.04c
1	3.61b	3.50b	5.06b
2	4.56a	4.26a	6.52a
Level of Significance	**	**	**
SE \pm	3.001	0.091	0.232
Interaction			
I * N	NS	NS	NS
I * W	NS	NS	NS
N * W	NS	NS	NS
I * N * W	NS	NS	NS

Means in a column followed by similar letter (s) are not statistically different by DMRT, NS = Not significant, ** = Significant at 1% level of probability

Straw Yield

Table 6 shows the result of the effects of irrigation interval, nitrogen levels and weeding regimes on straw yield of triticale. The result revealed that, except at 2014 where irrigation interval had no significant ($P \leq 0.05$) effect on straw yield, irrigation at 5 and 7 days interval produced significantly ($P \leq 0.05$) higher straw yield than the other intervals considered. The effect of nitrogen on straw yield was highly significant ($P \leq 0.05$). Straw yield increases with increase in nitrogen rates. Nitrogen applied at 120 kg ha⁻¹ produced significantly heavier straw yield. The response of straw yield to weeding regimes was highly significant ($P \leq 0.05$). Higher straw yield was obtained under two weeding at 20 and 40 DAS.

Table 6: Response of Triticale to Irrigation intervals, Nitrogen levels and Weeding regimes
On Straw Yield (t ha^{-1})

		Straw yield (t ha^{-1})		
Treatment		2014	2015	2016
Irrigation interval (days)				
5		6.295	6.282a	6.313a
7		6.296	6.264b	6.312a
9		6.296	6.263b	6.304b
Level of Significance		NS	**	**
SE \pm		0.0071	0.0022	0.0018
Nitrogen level (kg ha^{-1})				
0		6.150d	6.125d	6.163d
60		6.265c	6.239c	6.277c
90		6.338b	6.310b	6.353 b
120		6.430a	6.403a	6.445a
Level of Significance		**	**	**
SE \pm		0.0082	0.0025	0.0021
Weeding regime (DAS)				
No weeding		5.858c	5.834c	5.869c
20		6.387b	6.361b	6.401b
20 & 40		6.642a	6.612a	6.658a
Level of Significance		**	**	**
SE \pm		0.0007	0.0022	0.0018
Interaction				
I * N		NS	NS	NS
I * W		NS	NS	NS
N * W		NS	NS	NS
I * N * W		NS	NS	NS

Means in a column followed by similar letter (s) are not statistically different by DMRT, NS = Not significant, ** = Significant at 1% level of probability

DISCUSSION

Increasing irrigation interval significantly affects yield characters of triticale. This indicated the importance of water in growth and development of triticale due to its effect on cell division and elongation. These findings agreed with previous investigation by Lado *et al.* (2005) and Ngwako *et al.* (2013) who reported that drought stress reduced number of tillers and number of grains per spike. Nitrogen fertilizer plays a vital role in yield of triticale. This result is in agreement with the work of Amjed *et al.* (2011) and Bishnupriya *et al.* (2018) who reported maximum vegetative growth yield characters with increase in nitrogen. Triticale yield characters and straw yield increases with increase in number of weeding due to less competition with weeds. The result obtained was in agreement with the work of Dadari *et al.* (2000) and Anon (2002) who reported an increase in spikelets spike^{-1} , grain weight spike^{-1} and straw yield in wheat when weeds were effectively controlled.



A significant interaction between irrigation intervals and nitrogen levels was noticed on yield characters and straw yield. The highest number of spikelets spike⁻¹ number of grain spike⁻¹, weight of spike, weight of grain spike and straw yield were recorded between 5 days irrigation interval and two weeding at 20 and 40 DAS. This better development of triticale under 5 days irrigation interval and two weeding could also be as a result of better moisture availability, which maintain the internal water balance of the plant.

CONCLUSION AND RECOMMENDATION

The result of this study showed that irrigation at 5 days interval produced highest yield and yield values while nitrogen applied at 120 kg N ha⁻¹ produced significantly maximum yield characters and straw yield compared to lower nitrogen rates. Similarly, weeding done twice at 20 & 40 DAS produced the best yield parameters and straw yield. Based on the result of this findings, irrigation at 5 to 7 days interval to triticale weeded at 20 and 40 days DAS with the application of 120 kg N ha⁻¹ can be adopted by farmers in the study area for higher grain and straw yield.

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