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Original Research Article

Effect of Chicken Manure, Nitrogenand Phosphorous Fertilizers on Growth and Yield of wheat (*Triticum aestivum* L.) at New Halfa Irrigated Scheme

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Abstract

A multi-location experiment was conducted at three locations of New Halfa irrigated scheme, Hajer, the Faculty and Elshebaik sites, for two consecutive seasons 2017/2018 and 2018/2019 to test the effect of 18 organo-chemical fertilizer levels on growth attributes, yield and yield components of two wheat genotypes Bohain and Debaira. The results of analyzed data showed that. In both seasons, the growth attributes, such as the plant height, number of leaves per plant, leaf area (cm^2) showed non-significant differences for both genotypes under the different 18 fertilizer levels at Hajer and the Faculty sites. However, these traits are significantly different ($P \leq 0.05$) for both genotypes at Elshebaik site. Contrary to the growth attributes, the effect of the organo-chemical fertilizer was highly significant ($P \leq 0.001$) for the yield and most of its components for both genotypes in both seasons and at the three sites of study. The yield of both genotypes at the three locations is better in the first season compared to the second one. Debaira yield for both seasons and at the three locations is better than the yield of Bohain. From this study, it is clear that the yield of both genotypes increased with addition of the organic manure. From the results obtained in this study, it could be concluded that, Debaira scored better yield per h (kg) compared to Bohain genotype in both seasons and at two locations, Chicken manure up to the rate of 4 ton /h. when combined with 43kg N/h and 43kg P/h improved the yield of both genotypes in both seasons and at the three locations.

Keywords: Effect, wheat, genotypes, manures, nitrogen, phosphorus, yield, growth attributes.

INTRODUCTON

Worldwide, wheat (*Triticum aestivum* L.) importance as food crop is well known. To meet the requirement of the consistency increasing world population (around 7 billion). Rosegrant and Agcaoili (2010) observed that the increase demand on wheat consumption by increasing world population must be met by annual increase in wheat production of 2% till 2050.Wheat is grown on 215.9 million hectares throughout the world, which produces 725.91 million tons of grain (USDA, 2015). The leading producing countries of wheat are USA, Canada, Australia, Russia China and Argentine. Among the Arabs countries, Iraq, Algeria, Tunisia, Egypt, and Sudan are the main producers (Hago, 2005). In Sudan wheat, is important stable food for a large number of citizens, especially in urban areas, Being a temperate cool crop, it is not indigenous to Sudan; yet it was traditionally grown since early times in the Northern states (Lat. 18-22º N) that are characterized by a relatively cooler and longer winter season than the center (Mohammed, 2011). The scarcity of land and high cost production in the Northern state, coupled with increasing demand for wheat consumption, led to the expansion of wheat growing area southward to irrigated schemes in central and eastern Sudan (Ageeb, 1993). Nitrogen and phosphorous play a vital role in growth, sunlight interception, dry matter accumulation and grain filling. Green, 1984 reported that, mineral nutrition has contributed significant increase in crop yields during the 20th century and 50 to 60% of the increase in crop yields worldwide was due to application of chemical fertilizers. Many researchers, stated that during the 21st century, the essential plant nutrients would be one of the factors limiting crop yields, especially in developing countries, the main factors responsible for low yield are less or more plant population and inadequate crop

nutrition (Abdelgader *et al.*, 2010, Abedi *et al.*, Zhou *et al.*, 2011). Wheat yields especially those of new developed genotypes are among the most depending nitrogen fertilization plant species (Hirel *et al.*, 2001). The use of nitrogen fertilizers increased 100 fold over the last 100years to improve grain yield and protein content (Giambalvo *et al*., 2010). N fertilization increased wheat biomass (Boukef*et al*., 2013), yield (Khan *et al*., 2009 and Tariq Jan *et al*., 2011) and protein content (Saint Pierre *et al.*, 2008). In fact, nitrogen is a constitutive component of chlorophyll and proteins affecting photosynthesis process (Tranavicienė *et al*., 2007). Cheema *et al*., 2003, reported that, maximum grain yield of 4293 kg/ ha., was obtained at a rate of 150-100-50, NPK fertilizer levels. The wheat needs of nitrogen is a complex trait depending on genotypes, years, sites, stage of development, soil type, tillage methods, crop rotation and amount and type of nitrogen fertilizer (López-Bellido *et al*., 2008). New Halfa irrigated scheme considered as one of the main commercial production area of wheat in Sudan. Wheat production at New Halfa area is restricted by adverse soil physical properties and deficiency in some of plant nutrients, particularly nitrogen and phosphorus.Therefor; the objective of this study is to investigate the effect of chicken manure, nitrogen and phosphorouson growth, yield and yield components of two wheat cultivars grown at three locations and for two seasons under irrigation conditions at New Halfa irrigated scheme, Sudan.

MATERIALS AND METHODS

The experiment was carried out for two consecutive seasons (2017/2018 and 2018/2019), at three sites of New Halfa irrigated scheme,Sudan, namely, Hajer (HA) representsSouth of the scheme, the Faculty of Agriculture and Natural Resources (FA) of the University of Kassala, represents Central area of the scheme and Elshebiake (SH) which representsNorth part of the scheme. (Latitude 15º 19´ N, Longitude 35 º 36´ E. and Altitude 450m asl.). The soil of the experimental site belongs to Khashmelgerba Series, classified as sodic Hap lusters, very fine smectitic, isohyperthermic with a clay percentage around 60% and pH in the range of 4.8 to 8.8. Two wheat cultivars seeds were obtained from the Agricultural Research Corporation (ARC) of New Halfa (Bohain andDebaira).Chicken manures, (¯ M, +M) at a rate of 4ton/h, three N- fertilizer levels in form of Urea 46%N, (ON, 1N, 2N), (1N= 43kg N/ha) and three levels of Phosphorous in form of super phosphate 53%P, (OP, 1P, 2P), (1P= 43kg P /ha) were applied after a month from sowing. The combination of these fertilizer levels resulted in eighteen levels as: ¯ M ONOP (No chicken manures, No N or P fertilizers, (Control),¯ M ON1P (43 Kg P/h), ¯ M ON2P (86 KgP/h),¯ M 1NOP (43 Kg N/h),¯ M 1N1P, (43 Kg N/h and 43Kg P/h)¯ M 1N2P(43 KgN/h, 86Kg P/h), ¯ M 2NOP(86Kg N/h) , ¯ M 2N1P (86Kg N/h,43Kg P/h), ¯ M 2N2P (86 Kg N/h, 86Kg P/h), +M ONOP(4ton Chicken manure /h), +MON1P4ton Chicken manure /h43Kg P/h, +MON2P(4ton Chicken manure /h, , 86Kg P/h),+M1NOP (4ton Chicken manure /h 43 Kg N/h), +M1N1P (4ton Chicken manure /h, 43 Kg N/h and 43Kg P/h),+M1N2P (4ton Chicken manure /h, 43 Kg N/h, 86Kg P/h) +M2NOP (4ton Chicken manure /h, 86 Kg N/h)+M2N1P(4ton Chicken manure /h, 86Kg N/h,43Kg P/h) +M2N2P 4ton Chicken manure /h, 86 Kg N/h, 86Kg P/h),At each location and in each season, a randomized complete block design with three replicates was used. The plot size was 4.5 x 6 m. Sowing date was 12th, and 14th of November, for the first and the second seasons, respectively. All cultural practices were done as recommended by (ARC). Data were collected on the following parameters: plant height (cm), Number of leaves/plant and Leaf Area (cm^2) as growth attributes and Number of Spikelets/Plant, Number, of Grains/Plant and Yield/h(Kg) as yield and yield components. All the data were analyzed according to the procedure described by Gomez and Gomez (1984). Using Statistix computer software package (version 9-1). Analysis of variance for all studied traits was carried out to test the significant differences among the treatments means. A comparison for each treatment mean was worked out using Duncan's Multiple Range Test (DMRT) at 0.05 probability level.

RESULTS AND DISSCUSSION

This multi-locations experiment was conducted at the three locations of New Halfa irrigated scheme, for two consecutive seasons 2017/2018 and 2018/2019 to test the effect of 18 organo-chemical fertilizer levels on growth attributes, yield and yield components of two wheat genotypes Bohain and Debaira,.

The effect of the fertilizer levels on the growth attributes was shown in Tables 1(a, b andc). In both seasons, the growth attributes, such as the plant height, number of leaves per plantand leaf area showed non-significant differences for both genotypes under the different 18 fertilizer levels at Hajer and the Faculty sites. However, these traits are significantly different ($P \leq 0.05$) for both genotypes at Elshebaik site, (data of plant height, for Debaira in the first season and for Bohain in the second season was not available).This indicate that the respond of both genotype for the different fertilizer levels is poor at the vegetative stage of development at Hajer and the Faculty sites. On the other hand, the respond of the two genotypes for the growth attributes under the 18 fertilizer levels is quite evident at Elshebaik site in both seasons. For example, Debaira at Elshebaik site in the second season recorded a highest plant height of 70.8 cm under fertilizer +M2N2P, whereas, the lowest height was 40.8 cm at +M0N0P fertilizer level an indicated that, both nitrogen and phosphorus fertilizer had increased the plant height. Similar results were reported by El-Fatih *et al.*, 2008. In contrast, at Elshebaik site in the first season, the leaf

area was significantly different (P≤0.05) for both genotypes. For example, Bohain, in the first season recorded a highest leaf area of 380.7 cm^2 at the fertilizer level of -M2N0P and a lowest leaf area of 88.2 cm at the fertilizer level of -M2N2P, which indicate that, increasing the phosphorus fertilizer will accelerate plant development towards the reproductive phase and declining the vegetative stage, thus the leaf size was decreased. Similar findings were reported by Malik *et al*., 1999. The number of leaves in wheat was probably considered as a varietal character, and thus they were not affected by the environment.

Contrary to the growth attributes, the effect of the organo-chemical fertilizer was highly significant (P≤0.001) for the yield and most of its components for both genotypes in both seasons and at the three sites of study, Tables 2(a, b and c). The yield of both genotypes at the three locations is better in the first season compared to the second one. The highest yield per/h(Kg) for Bohain in the first season at Hajer, the Faculty and Elshbaik was 2927, 2545 and 3805 Kg under the fertilizer of + M 0N2P, - M0N2P and +M 2N1P, respectively. Whereas, Debaira scored a highest yield of 2607, 2375 and 3774 Kg under the fertilizer level of+M2N1P, +M1N2P and +M1N1P at the three respective sites. On the other hand, in the second season, Bohain highest yield was 1113, 1296 and 1203 Kg /h at Hajer, the Faculty and Elshbaik sites, under the fertilizers of +M0N0P, -M1N0P, +M0N1P respectively, whereas, Debaira recorded a highest yield of 1069, 1254 and 1865Kg at fertilizer rates of +M1N0P, +M1N1P and+M0N2P at the three respective sites. The lowest yield for Bohain at Hajer, the Faculty and Elshbaik sites in the first season was 1544, 1063 and 1531 Kg under fertilizer of –M1N0P, +M2N1P and –M2N1p whereas, in the second season the lowest yield was 659, 167 and 472 Kg under the fertilizer level of –M1N0P, -M2N1P and +M2N0P, respectively. In contrast Debaira recorded a lowest yield of 1648, 1529 and 1864 Kg in the first season under the fertilizer level of –M2N1P,-M2N2P and –M1N0P, and 496, 384 and772 Kg in the second season under the fertilizer level of +M2N2P,+M0N0P and –M2N0P, at the three respective locations.

In general, the grand mean of yield per h (Kg) for Debaira at Hajer, the Faculty and Elshebaik sites was 1976, 1821 and 2805 Kg, in the first season and 886, 754 and 1257 Kg in the second season, respectively. Whereas, Bohain recorded a grand mean of 2345, 1747 and 2233 Kg in the first season and 872, 475 and 846 Kg in the second season at the three respective locations. It is quite evident that Debaira yield for both seasons and at the three locations is better than the yield of Bohain. The yield per m^2 for Debaira at Elshbaik is better than at Hajer and the Faculty by 54% and 45.6% in the first season, and by 41.9% and 66.7% in the second season, whereas, the yield for Bohain at Hajer is better than at the Faculty and Elshebaik by 34.2% and 5% in the first season and by 15.6% and 3% in the second season. Therefore, Debaira was suitable for Elshbaik site, whereas, Bohain was suitable for Hajer site.

From this study, it is clear that the yield of both genotypes increased with addition of the organic manure. Adam and Ali, (2004), reported that the yield of wheat genotypes increased with addition of chicken manure up to 45 ton /ha, due to activation of the soil micro-organisms, improving of the soil physical properties and increasing the soil water holding capacity. Moreover, addition of organic manure together with 1N and 1P resulted in higher yield compared to untreated wheat production, for example, in the first season, treated Debaira yield with manure exceeded the untreated one by 58.2% at Hajer and by 55.3% at the Faculty site and by 102.4% at Elshbaik site, like wise Bohain treated yield with organic manure out yielded the untreated one in the first season by 88.2% at Hajer and by 148.5% at Elshebaik site. This probably due to the fact that, the organic manure facilitate the availability and absorption of both nitrogenphosphorus. The result is inconformity with findings of Ali *et al*., (1999) who reported that application of organic manure resulted in 21.17% increase in wheat yield than untreated control. Increasing the nitrogen fertilizer up to two level (2N) will delay the crop to be shifted from the vegetative phase to the reproductive stage and therefore, will delay the flowering stage which resulted in declining the yield. Similar findings were reported by Kausar *et al*., (1993) who stated that high level of nitrogen promoted vegetative growth. In this study, application of nitrogen and phosphorous fertilizers at a rate of 1N and 1P improved the yield of both genotypes almost in both seasons and across the three locations compared to 2N and 2P doses. Abbas *et al.*, 2007 stated that, application of phosphorus at a rate of 1P and 2P, were significantly (P≤ 0.05) superior over the 0P for all parameters studied in corn. However, there was no significant difference between both rates of added P (1P and 2P) for all parameters including yield.

From the results obtained in this study the following recommendation could be drawn:

1. Organic manure up to rate of 4 ton/h. when combined with 1N = (43kg N/h) and 1P = (43 Kg P/h) improved yield of both genotypes in both seasons and at the three locations.
2. The yield per h (kg) of Debaira at Elshbaik is better than at Hajer and the Faculty by 54% and 45.6% in the first season, and by 41.9% and 66.7% in the second season, whereas, the yield of Bohain at Hajer is better than at the Faculty and Elshebaik by 34.2% and 5% in the first season and by 15.6% and 3% in the second season. Therefore, Debaira is suitable for Elshbaik site, whereas, Bohain is suitable for Hajer site.

Table (1a): Means of plant height (cm), number of leaves/plant and leaf area (cm^2) of the two genotypes, Bohain(B) and Debaira(D) grown under the 18 fertilizer levels at Hajer site for two seasons 017/2018 and 018/2019

Fertilizer Level	Plant height (cm)				Number of leaves /plant				Leaf area (cm^2)			
	2017/018		2018/019		2017/018		2018/019		2017/018		2018/019	
	B	D	B	D	B	D	B	D	B	D	B	D
-M0N0P*	73.47	79.93	55.27	57.07	24.73	24.93	32.00	26.13	424.9	577.5	350.36	884.5
-M0N1P	64.87	80.73	54.20	59.87	23.00	26.40	23.20	31.87	422.7	606.7	310.78	1161.3
-M0N2P	69.93	76.67	53.27	57.40	24.33	25.47	32.67	33.20	423.9	623.3	359.66	1367.1
-M1N0P	73.27	76.73	53.47	57.07	23.40	23.93	29.20	36.93	442.3	569.9	353.83	1337.7
-M1N1P	67.73	80.33	54.00	58.40	24.67	26.93	22.40	33.40	395.2	683.8	262.81	1307.8
-M1N2P	70.93	82.80	55.00	57.60	22.27	26.67	26.13	33.93	266.5	662.4	349.61	1350.0
-M2N0P	67.67	82.80	54.60	56.47	23.07	25.93	29.60	39.47	405.0	701.3	457.21	1789.9
-M2N1P	67.93	78.27	57.73	58.40	22.53	24.20	22.67	35.00	351.9	517.1	346.05	1350.3
-M2N2P	62.60	80.13	54.13	58.40	22.67	24.73	24.73	29.67	376.7	649.1	361.28	1235.8
+M0N0P	67.13	74.47	52.40	58.00	22.93	23.93	25.60	22.67	347.6	433.4	374.84	769.0
+M0N1P	67.27	76.73	52.40	58.27	23.33	25.47	24.00	23.60	400.0	635.3	325.27	971.8
+M0N2P	70.53	79.87	56.80	58.67	24.80	26.87	25.33	32.13	667.2	631.0	360.72	1276.0
+M1N0P	72.13	78.60	56.80	57.47	24.27	25.33	25.33	32.67	395.8	576.0	355.88	1144.6
+M1N1P	69.13	74.47	50.60	58.00	22.73	25.40	23.73	30.67	427.0	754.7	331.22	1249.5
+M1N2P	68.73	82.07	55.87	57.33	25.13	27.20	27.47	29.33	400.5	619.5	420.12	868.8
+M2N0P	70.47	75.10	52.73	59.07	24.07	25.13	26.67	24.47	470.1	648.4	358.11	836.9
+M2N1P	66.27	83.60	56.47	60.60	22.67	24.93	26.67	28.27	370.2	654.9	394.58	600.8
+M2N2P	66.20	75.40	53.00	59.00	24.67	24.13	28.00	29.87	416.7	530.2	382.25	1066.2
G.M	68.68	78.82	54.37	58.17	23.63	25.42	26.41	30.74	411.3	615.3	358.59	1142.7
S.E	3.40	3.95	2.06	3.16	3.22	2.73	8.83	11.01	199.4	188.4	132.27	619.54
C.V%	6.06	6.14	4.65	6.66	8.21	6.47	20.15	21.58	29.22	18.46	22.23	32.68
Sig.L	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S	*

*,**,*** significant at 0.05,0.01 and 0.001 probability level ; NS, Not significant

* -M= No chicken, +M= 4ton chicken manures/h, 0N= No nitrogen, 1N=43kg N/h, 2N= 86kg N/h, 0P= No phosphorus, 1P= 43kgP/h, 2P= 86kgP/h.

Table (1b): Means of plant height (cm), number of leaves/plant and leaf area (cm^2) of the two genotypes, Bohain (B) and Debaira (D) grown under 18 fertlizer levels at the Faculty site for two seasons 017/2018 and 018/2019

Fertilizer Level	Plant height (cm)				Number of leaves/plant)				Leaf area (cm^2)			
	2017/018		2018/019		2017/018		2018/019		2017/018		2018/019	
	B	D	B	D	B	D	B	D	B	D	B	D
-M0N0P	59.20	58.60	55.40	56.80	11.4	19.2	22.07	19.13	198.55	511.27	223.27	153.54
-M0N1P	55.47	58.20	49.53	56.27	15.6	16.9	16.00	16.73	265.64	391.58	151.12	179.16
-M0N2P	55.87	59.00	51.60	56.93	14.0	18.4	16.33	15.93	262.88	386.40	128.89	148.03
-M1N0P	58.00	56.07	48.07	58.73	17.4	18.6	18.87	19.33	267.90	400.42	193.45	299.79
-M1N1P	53.80	56.67	49.73	56.80	17.6	14.6	16.27	17.47	248.11	466.86	213.68	202.60
-M1N2P	58.20	56.27	48.97	57.47	12.2	21.7	16.33	14.67	193.92	540.24	108.58	125.31
-M2N0P	57.27	55.80	47.00	57.87	14.0	17.6	19.73	23.07	244.38	359.65	209.37	273.39
-M2N1P	59.87	59.27	49.33	60.93	23.0	18.4	12.40	25.40	452.65	495.25	70.48	324.16
-M2N2P	58.07	58.93	57.13	60.93	17.4	21.1	18.40	18.73	250.83	571.66	123.81	169.50
+M0N0P	55.40	55.47	47.87	55.73	17.6	20.1	19.67	18.20	332.39	493.20	129.35	219.38
+M0N1P	58.07	59.53	47.27	54.40	14.2	17.0	19.87	17.20	206.42	421.45	179.22	141.00
+M0N2P	56.07	58.27	48.87	50.87	15.0	16.4	17.33	17.93	268.50	399.80	174.64	166.79
+M1N0P	55.60	57.90	48.20	55.33	19.2	21.3	18.20	24.40	328.7	491.5	168.49	247.29
+M1N1P	57.33	56.93	54.13	52.60	13.3	20.8	22.27	18.60	193.20	430.27	271.52	250.67
+M1N2P	56.80	55.87	50.40	57.07	23.7	17.2	20.33	24.73	388.90	318.02	323.71	192.13
+M2N0P	60.47	56.87	49.87	57.00	14.8	19.0	14.40	26.40	246.91	531.50	170.66	290.19
+M2N1P	56.80	59.07	54.27	64.67	14.5	24.9	21.73	21.80	259.94	608.06	173.49	207.98
+M2N2P	54.73	55.53	53.00	54.90	14.2	19.3	21.33	26.40	233.06	415.94	328.75	266.91
G.M	57.06	57.46	50.59	56.96	16.1	19.0	18.42	20.34	269.04	457.40	185.69	214.32
S.E	6.52	6.08	10.96	8.26	6.80	5.27	5.32	10.32	163.38	223.19	133.21	170.79
C.V%	6.89	6.38	13.06	8.74	25.4	16.6	17.40	30.56	36.60	29.41	43.23	48.02
Sig.L	N.S.	N.S.	55.40	N.S.	*	*	*	N.S.	N.S	N.S	*	N.S

*,**,*** significant at 0.05,0.01 and 0.001 probability level ; NS, Not significant

Table (1c): Means of plant height (cm), number of leaves/plant and leaf area (cm^2) of the two genotypes, Bohain (B) and Debaira(D) grown under 18 fertilizer levels at Elshebaik site for two seasons 017/2018 and 018/2019

Fertilizer Level	Plant height (cm)				Number of leaves / plant)				Leaf area(cm^2)			
	2017/018		2018/019		2017/018		2018/019		2017/018		2018/019	
	B	D	B	D	B	D	B	D	B	D	B	D
-M0N0P	68.40	N.A	N.A	49.60	29.4	32.3	22.37	18.53	289.73	361.72	67.55	209.94
-M0N1P	68.07	N.A	N.A	51.47	26.0	24.0	24.53	18.47	251.59	280.69	73.47	147.54
-M0N2P	64.67	N.A	N.A	54.43	22.5	30.2	20.53	19.73	216.25	415.25	61.34	160.83
-M1N0P	66.40	N.A	N.A	58.60	23.4	24.4	15.93	21.07	118.17	425.30	84.89	252.61
-M1N1P	64.20	N.A	N.A	52.20	24.4	25.0	17.73	18.80	163.47	314.62	47.62	73.12
-M1N2P	80.00	N.A	N.A	58.40	15.6	22.2	17.13	16.87	113.35	213.63	79.76	75.76
-M2N0P	59.80	N.A	N.A	58.20	40.4	26.7	25.73	16.47	380.76	485.18	133.71	42.47
-M2N1P	69.00	N.A	N.A	54.20	22.8	24.4	22.40	22.40	217.39	340.54	144.29	205.57
-M2N2P	58.00	N.A	N.A	57.00	31.8	25.3	19.20	19.67	88.21	462.78	104.04	65.90
+M0N0P	70.40	N.A	N.A	46.80	27.0	23.7	24.87	16.60	287.67	333.28	104.35	105.28
+M0N1P	69.60	N.A	N.A	69.40	17.6	23.7	23.20	16.13	96.44	519.53	105.78	181.48
+M0N2P	67.80	N.A	N.A	57.00	19.8	28.1	19.40	16.53	162.42	439.94	182.81	119.21
+M1N0P	70.80	N.A	N.A	64.80	30.3	29.9	19.80	17.33	345.61	386.19	110.37	181.20
+M1N1P	65.20	N.A	N.A	49.40	26.3	25.7	24.27	19.20	176.56	409.75	101.76	234.74
+M1N2P	62.60	N.A	N.A	64.40	32.3	22.4	24.00	20.33	147.25	188.23	101.39	190.16
+M2N0P	67.60	N.A	N.A	65.00	20.2	28.7	15.53	16.40	127.35	370.05	60.80	72.48
+M2N1P	69.20	N.A	N.A	63.80	26.2	21.0	19.07	17.73	201.17	401.06	61.12	70.25
+M2N2P	71.00	N.A	N.A	70.80	44.5	23.8	25.20	25.60	271.79	232.36	70.28	195.42
G.M	67.37	N.A	N.A	58.08	26.6	25.6	21.16	18.77	203.07	365.56	94.18	143.55
S.E	6.72	N.A	N.A	2.32	6.16	0.38	1.71	0.49	146.26	7.54	23.83	3.82
C.V%	6.01	N.A	N.A	2.41	13.7	0.88	4.86	1.57	43.41	1.24	15.25	1.60
Sig.L	***	N.A	N.A	***	***	***	***	***	**	***	***	***

*,**,*** : significant at 0.05,0.01 and 0.001 probability level ; NS: Not significant, NA : Not available

Table (2a): Means of number of spikelets/plant), number of grains/plant and grain yield(g/m^2) of the two genotypes, Bohain (B) and Debaira(D) grown under 18 fertilizer levels at Hajer site for two seasons 017/2018 and 018/2019

Fertilizer Level	Number of spike lets/plant				Number of grains /plant				Grain yield Kg/h			
	2017/018		2018/019		2017/018		2018/019		2017/018		2018/019	
	B	D	B	D	B	D	B	D	B	D	B	D
-M0N0P	59.97	77.3	46.47	22.40	99.1	167.	70.27	46.00	2373.3	1856.7	883.2	875.3
-M0N1P	62.73	68.7	38.33	40.93	102.	178.	64.67	60.67	24.6.7	1915.0	898.5	1031.4
-M0N2P	60.90	38.1	42.13	33.13	113	147.5	59.20	30.93	2562.0	2225.0	989.8	1028.0
-M1N0P	75.80	67.6	41.80	35.47	115.	134.6	72.27	51.73	1544.3	1817.3	659.1	864.6
-M1N1P	91.20	62.4	46.67	42.47	177	151.3	72.07	58.20	2247.3	1672.7	938.4	852.6
-M1N2P	75.10	79.4	42.00	52.20	111.	212.	78.00	69.47	1848.0	2013.3	798.7	956.0
-M2N0P	50.07	65.7	37.87	32.53	101.	183.	87.00	42.27	2897.3	2129.7	912.2	884.7
-M2N1P	60.40	58.9	42.40	45.67	104.	150.	72.33	55.87	2721.3	1648.3	874.4	608.8
-M2N2P	51.27	54.7	46.93	44.60	133.	147.	83.47	72.67	2561.0	2176.0	694.1	779.0
+M0N0P	69.17	63.3	56.93	38.27	102.	164.0	90.80	50.13	2054.0	1702.0	1113.4	1052.2
+M0N1P	64.10	57.2	57.40	55.67	107.	146.	97.53	77.07	2047.3	2019.0	932.9	1044.9
+M0N2P	68.93	64.1	46.30	42.53	116.	155.0	65.87	60.60	2927.7	1794.0	774.9	878.7
+M1N0P	77.83	55.7	33.20	55.67	140.	175.3	64.47	73.40	2077.3	1858.7	815.4	1069.6
+M1N1P	66.67	55.3	37.27	44.67	110.	144..	75.67	51.00	2403.3	2161.3	801.0	1005.
+M1N2P	58.60	63.7	41.67	46.53	107.	175.6	85.27	87.13	2397.0	2074.0	807.9	755.5
+M2N0P	78.07	58.8	48.73	47.07	114.	151.2	81.93	59.27	2363.7	1869.0	864.5	912.4
+M2N1P	75.23	70.6	54.27	41.13	117.	203.0	71.13	62.33	2641.0	2607.0	988.6	848.8
+M2N2P	52.77	62.0	46.87	28.13	93.8	151.0	56.47	64.53	2120.0	2023.0	949.6	495.5
G.M	66.60	61.5	44.85	41.62	114.	163.1	74.91	59.63	2344.6	1975.7	872.0	885.7
S.E	7.87	14.1	9.31	10.81	17.3	14.22	11.51	10.90	10.16	28.80	10.04	13.53
C.V%	7.12	13.8	12.51	15.66	9.09	5.25	9.26	11.02	2.61	8.79	6.94	9.21
Sig.L	***	***	***	***	***	***	***	***	***	***	***	***

*,**,*** significant at 0.05,0.01 and 0.001 probability level ; NS, Not significant

Table (2b): Means of number spikelets/plant), number of grains/plant and grian yield (g/m^2) of the two genotypes, Bohain(B) and Debaira(D) grown under 18 fertilizer levels at the Facultyr site for two seasons 017/2018 and 018/2019

Fertilizer Level	Number of spike lets/plant				Number of grains /plant				Grain yield / m^2			
	2017/018		2018/019		2017/018		2018/019		2017/018		2018/019	
	B	D	B	D	B	D	B	D	B	D	B	D
-M0N0P	73.50	70.0	19.87	19.87	224.63	178.63	40.33	83.33	1603.3	1545.7	299.8	611.2
-M0N1P	72.07	63.6	51.27	51.27	216.20	143.60	72.40	73.67	1680.0	2086.7	375.6	765.3
-M0N2P	78.43	99.3	26.80	26.80	234.10	157.23	54.67	121.33	2543.3	1550.0	425.1	1098.3
-M1N0P	93.77	78.5	13.67	13.67	284.00	198.37	39.07	40.33	1343.3	1736.7	1298.3	808.4
-M1N1P	82.53	67.3	27.33	27.33	228.67	156.53	46.60	73.67	1654.7	2121.7	1021.7	849.0
-M1N2P	70.00	70.5	17.33	17.33	239.20	163.40	64.00	80.67	2011.0	1819.3	368.7	609.0
-M2N0P	91.47	53.1	11.87	11.87	276.23	162.80	23.00	39.67	1446.7	1675.7	663.9	689.3
-M2N1P	89.17	65.1	31.13	31.13	263.00	164.23	55.87	67.00	1756.7	1563.0	166.7	679.6
-M2N2P	100.63	86.7	15.67	15.67	161.33	164.97	30.33	65.33	1333.3	1529.7	212.6	484.4
+M0N0P	89.2	76.7	35.53	35.53	267.60	142.63	63.33	87.00	1690.0	1779.3	183.0	384.4
+M0N1P	125.67	80.6	34.87	34.87	367.67	180.53	58.00	80.33	1623.3	1697.3	302.0	582.6
+M0N2P	135. 3	63.2	24.13	24.13	413.57	169.97	55.40	126.00	1460.0	2019.0	342.7	388.4
+M1N0P	110.43	91.3	26.20	26.20	328.00	164.33	50.33	86.67	2006.7	1723.7	403.0	700.9
+M1N1P	82.30	86.6	26.73	26.73	296.53	220.80	58.53	73.00	2080.0	1724.7	451.2	1253.9
+M1N2P	127.50	69.3	30.00	30.00	334.90	142.13	50.40	68.00	2113.3	2375.7	671.0	754.5
+M2N0P	151.50	68.33	10.60	10.60	351.33	152.50	62.00	51.33	1978.3	1694.0	823.3	714.0
+M2N1P	75.07 i	86.20	16.13	16.13	231.40	153.23	64.00	62.67	1063.3	2289.3	286.3	964.1
+M2N2P	89.07	65.33	20.40	20.40	263.10	165.30	38.13	81.67	2056.7	1853.3	260.6	1237.0
G.M	96.55	74.56	24.42	24.42	276.75	165.62	51.47	75.65	1746.9	1821.4	475.3	754.1
S.E	8.18	5.73	3.17	3.17	30.10	8.94	4.79	4.64	7.27	8.76	5.70	4.61
C.V%	10.38	9.41	15.91	15.91	13.32	6.61	11.37	7.51	5.10	5.89	5.89	7.48
Sig.L	***	***	***	***	***	***	***	***	***	***	***	***

*,**,*** significant at 0.05,0.01 and 0.001 probability level ; NS, Not significant

Table (2c): Means of number of spike lets/plant, number of grains/plant and grain yield(g/m^2) of the two genotypes, Bohain (B) and Debaira (D) grown at Elshebaik site for two seasons 017/2018 and 018/2019 under 18 fertilizer levels

Fertilizer Level	Number of spike lets/plant				Number of grains /plant				Grain yield g/m^2			
	2017/018		2018/019		2017/018		2018/019		2017/018		2018/019	
	B	D	B	D	B	D	B	D	B	D	B	D
-M0N0P	77.93	87.57	9.53	13.13	112.83	260.00	22.07	28.13	1791.7	2251.0	657.7	1665.0
-M0N1P	86.20	54.27	10.67	11.87	171.67	285.00	16.40	23.80	1537.0	2070.7	766.7	872.7
-M0N2P	49.33	60.17	11.00	11.80	147.53	498.33	9.93	22.60	1649.7	2307.7	846.3	1246.7
-M1N0P	75.93	66.83	6.67	10.93	238.00	250.00	19.07	28.20	1761.7	1863.7	643.3	1362.0
-M1N1P	87.93	89.67	9.60	12.73	245.10	280.00	21.07	34.67	1664.7	2551.3	805.0	1124.3
-M1N2P	72.73	72.53	10.33	12.07	192.33	186.67	19.40	31.47	1585.7	2588.7	1046.3	1104.7
-M2N0P	102.63	92.17	9.53	12.67	294.00	237.67	20.47	27.00	1840.0	2266.7	576.3	771.7
-M2N1P	71.10	75.20	9.40	12.87	205.67	201.33	18.27	34.87	1531.0	2510.0	878.0	906.3
-M2N2P	68.80	74.53	11.93	10.73	202.00	201.00	26.27	25.93	1850.3	3493.0	923.7	1078.7
+M0N0P	67.87	81.17	11.60	14.00	203.67	224.67	27.13	29.60	1737.0	3198.0	853.0	1181.0
+M0N1P	91.93	100.57	10.53	14.13	264.77	304.40	24.53	33.07	2569.0	2845.0	1203.3	1663.3
+M0N2P	109.93	53.53	10.07	12.87	300.00	136.67	21.80	32.13	3735.0	3634.3	965.7	1864.7
+M1N0P	96.00	73.00	10.60	14.67	287.57	204.00	22.13	27.07	3392.0	3000.0	1128.3	944.0
+M1N1P	85.07	94.33	9.73	13.60	126.83	272.67	18.07	33.80	2749.7	3772.7	679.0	1221.3
+M1N2P	89.43	88.13	11.13	12.67	138.23	255.00	25.40	27.33	2230.7	3251.3	985.0	1569.7
+M2N0P	78.57	76.00	9.00	13.93	105.67	213.33	19.20	30.07	3147.7	3240	472.0	1158.7
+M2N1P	83.73	105.27	9.67	13.33	224.10	191.67	21.60	39.47	3805.3	2577.0	803.0	1347.7
+M2N2P	105.27	80.10	9.80	13.67	212.33	226.67	23.00	28.00	1610.7	3060.7	998.7	1542.0
G.M	83.36	79.17	10.04	12.87	204.02	246.06	20.88	29.84	2232.7	2804.6	846.2	1256.9
S.E	9.89	11.04	2.53	3.30	25.68	226.70	6.14	4.74	63.78	18.44	12.40	9.77
C.V%	7.15	8.40	15.20	15.47	7.58	55.52	17.72	9.56	17.22	3.96	8.83	4.68
Sig.L	***	***	N.S	N.S	***	N.S	***	***	***	***	***	***

*,**,*** significant at 0.05,0.01 and 0.001 probability level ; NS, Not significant.

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