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EFFECT OF NITROGEN RATES AND IRRIGATION REGIMES ON YIELD AND YIELD COMPONENTS OF BREAD WHEAT (*Triticum aestivum* L.) GENOTYPES UNDER NEWLY RECLAIMED LAND CONDITIONS

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ABSTRACT

The present investigation was carried out during 2002/2003 and 2003/2004 growing seasons at Nubaria Agriculture Research Station. A split split plot design was used. The objectives of this investigation was aimed to study the effect of irrigation treatments (two, three and five irrigations), the nitrogen fertilizer rates (72, 144 and 216 Kg N / ha) on productivity of some bread wheat genotypes. The main results could be summarized as follows:

1- Results showed that full irrigation treatments significantly maximized grain yield / ha and its components. There is insignificant differences between two irrigations treatment or three irrigations treatment on number of spikes/m^2 and number of grains / spike, grain yield /ha which reduced by 17.57 and 4.82 % compared with full irrigation treatment.
2- Increasing nitrogen fertilizer rates from 72, 144 to 216 Kg N/ha significantly increased number of spikes/m^2, number of grains / spike, straw, grain and biological yields /ha and harvest index.
3- Results indicated that Bhrikuti, CM 85836 and ICW 92 genotypes were recorded highest grain yield /ha, number of grains / spike, and 1000 grain weight without significant differences between them.

In general, it could be recommended that utilization of five irrigations and addation of 216 Kg N /ha could give the highest wheat yield under newly reclaimed land conditions.

INTRODUCTION

Wheat is one of the most important grain crops in Egypt . It occupies the first position among cereals. Many efforts had been made to increase wheat production, either by releasing new varieties or by suitable practices of technical package such as irrigation and nitrogen fertilization. In this respect, many investigators found that yield and yield components were increased by irrigation in certain stages of wheat (Eman,2000 and Maliwal *et al.*,2000). Others found that number of irrigations is more important than the time of irrigation on yield and yield components of wheat (Gadoury and Hess (2002). Kimurto *et al* (2003) found that terminal and early drought caused significant reduction in tillers number and number of reproductive tillers.

Some scientists found that the levels of N-fertilizer increased the yield and yield components until certain level. The further N levels decreased the yield of wheat crop. (Moustafa *et al* (1997), Abad *et at* (2000) where increasing N fertilizer higher was not economic (Shahjehan *et at* (2000). Many investigators revealed that various genotypes and their yield components widely differed under drought stress and N levels (Malesevic *et al.*,1990; Shalaby *et al.*, 1992; Allam, 2003 and Arzani, 2002). The aim of this investigation was screening different wheat genotypes for low input in water and nitrogen fertilization in two field trials on yield and its components.

MATERIALS AND METHODS

The present investigation had been carried out on the experimental farm of Nubaria Agricultural Research Station, representing calcareous soils with sandy loam texture under surface irrigation conditions during two growing seasons 2002/2003 and 2003/2004. Soil physical and chemical analyses and presented in Table 1. Materials can be illustrated as following:

Table 1: Chemical, physical and nutritional characteristics of surface (0-25 cm) and sub-surface (25-50 cm) soil samples for the experimental site in 2002/2003 and 2003/2004 seasons.

Characteristics	2002 / 2003		2003 / 2004	
	Surface	Sub-surface	Surface	Sub-surface
Ph	8.20	8.35	8.00	8.30
Ec.dS m^{-1}	0.40	0.65	0.62	0.85
$CaCO_3$ %	24.50	21.00	27.50	23.50
Soil texture	Sandy loam	Sandy loam	Sandy loam	Sandy loam
Silt +clay %	14.3	18.9	16.4	21.2
Sand %	85.7	81.1	83.6	78.8
NH_4+NO_3-N ug/g	35.00	41.50	20.50	21.15
Av.-P ug/g	18.0-20.0	10.0-12.0	10.0-12.0	7.0-8.0
Exch-K ug/g	310-370	250-270	290-310	230-250
Field capacity	26.4	22.7	27.5	23.4
Wilting Point %	14.4	12.3	15.1	12.7
Av. Water	12.1	10.4	11.5	10.7
Bulk density	1.05	1.16	1.12	1.25

Bread wheat genetic materials

Eight bread wheat genotypes (*Triticum aestivum L.*) were selected from exotic material from CIMM YT and ICARDA, names and pedigree are showed in Table 2.

Irrigation regimes:

1- Planting irrigation + one supplementary irrigation ,applied at tillering stage i.e two irrigation. (I)
2- Planting irrigation + two supplementary irrigation ,applied at tillering and booting stage i.e. three irrigation. (II)
3- Control treatment as recommended in the experimental site i.ei five irrigations. (III)

Nitrogen fertilizer treatments:

Nitrogen fertilizer in the form of ammonium nitrate (33.5 %) treatment include three levels:

1- 30 Kg N/ fad i.e. 72 kg N/ha (N1)
2- 60 Kg N/ fad i.e. 144 kg N/ha (N2)
3- 90 Kg N/ fad i.e. 216 kg N/ha (N3)

Table 2: Names and Pedigree of eight genotypes of bread wheat used in the Present study.

Genotype	Name / Pedigree	Origin
1	BHRIKUTI NL-623-0NP	CIMMYT
2	IRENA /WEAVER CMBW90-M294-1M-010Y-010M-010Y-6M-015Y-0Y	CIMMYT
3	K134(60)/4/TOB/BMA//BB/3/CAL/5/BUC CM103564-5M-030M-020Y-010M-1Y-010Y-0M-0AP	ICARDA
4	SAF1-1 CM103448-39M-030M-020Y-010M-4Y-010Y-0M-0AP	ICARDA
5	ATTILA-3 CM85836-4Y-0M-0Y-14M-0Y-5M-0Y-15J-0Y-0AP	ICARDA
6	DAJAJ-1 ICW92-0281-1AP-2AP-0L-1AP-0AP	ICARDA
7	GEMMIZA 7 CMH74 A.630/5x//Seri 82/3/Agent CGM 4611-2GM-3GM-1GM-0GM	Egypt
8	GIZA 168 MIL/BUC//Seri CM93046-8m-0y-0M-2Y-0B	Egypt

A split-split plot design with four replicateswas used. Irrigation treatments were distributed in the main plots. Nitrogen fertilizer levels in the sub plots. Wheat genotypes were allocated in the sub-sub plots. Soil samples were taken before planting to determine mineral nitrogen content of the soil and experimental site was left fallow during the summer season . Land preparation was done using chisel plow twice, then disc plow and followed by rotravator to fine seed bed. Phosphorus was added as superphosphate (15.5% P_2O_5) at a rate of 15.5 kg P_2O_5 per faddan. Potassium at rate of 24 kg K_2O per faddan during land preparation. Nitrogen fertilizer at a bove mentioned rates in the form of ammonium nitrate (33.5 % N) was added at three doses at in planting, after 25 days from planting and after 55 days from planting. Seeds were drilled in the rows by hand on November 28/ 2002 in the first season and November 20/2003 in the second season (the optimum sowing date in Nubaria region is from 15 to 30 November). The seeding rate was calculated to achieve a density of 350 seed /m^2 according to each genotype kernel weight for both seasons.

Studied characters:

At harvest time the central (guarded) four rows of each plots with 2.5 meter long were cut by hand and mechanically threshed (harvested area = $2m^2$). Data were recorded for yield and its components on the following characters:

1- Grain yield (ton/ha): grain yield per plot was estimated as the weight of clean grains of each plot which was converted to ton per hectare.
2- Biological yield (ton/ha): the weight of total above ground dry matter of each plot was converted to ton per hectare.

3- Number of spikes per m^2 (No. of tillers bearing fertile spikes): was estimated by counting the number of spikes in two random area of one meter long.
4- Number of kernels per spike: recorded as the average number of kernels per ten spikes taken at random from each plot.
5- One thousand kernel weight: recorded as the average of two samples with one thousand kernel of clean grain from each plot.
6- Straw yield: the weight of total above ground dry matter of each plot minus grain yield. (Biological yield – Grain yield).
7- Harvest index (HI): recorded as a ratio of grain yield to the total above ground dry matter of each plot (HI = Grain yield / Biological yield) X 100.

Data were subjected to the proper statistical analysis of variance for their combined analysis over the two seasons according to Snedecor and Cochran (1967). For comparison between means the F-LSD were used and ANOVA commands set in SAS program.

RESULTS AND DISCUSSIONS

A. Effect of irrigation treatments:

Means of yield and its components as affected by irrigation treatments are presented in Table 3. The highest mean values of the studied traits were produced from plants received five irrigations (full irrigation) and exhibited significant increase in all the studied traits compared to other irrigation treatments. However, significant decreases in its values for all the studied traits by using the other two irrigations treatments.

Table 3: Means of number of spikes / m^2, number of kernels /spike, 1000- kernel weight (g), straw yield t/ha, grain yield t/ha, and biological yield t/ha as affected by irrigation treatments.

Irrigation Treatments	Number of spikes/ m^2	Number of kernels/ spike	1000- kernel weight (g)	Straw yield (t /ha)	Grain yield (t /ha)	Biological yield (t/ha)	Harvest index
I	319.8 b	41.3 b	40.7 c	10.9 c	5.3 c	16.2 c	0.33 b
II	351.5 a	43.2 a	44.3 b	12.1 b	6.1 b	18.2 b	0.34 a
III	362.9 a	43.6 a	46.2 a	13.0 a	6.4 a	19.4 a	0.33 a

I= Two irrigations, II=Three irrigations III= Five irrigations
Means with the same letter are not significantly different.

The negative effect on yield and its components was caused by skipping an irrigation could be explained on the basis of the loss of turgor which effects the rate of cell expansion and ultimate cell size. Thus effect cf water stress on cell division and enlargement has been carefully discussed by Kramer and Boyer (1995). For number of spikes/m^2, and number of kernels /spike, mean values detected herein indicated that plants received five irrigations or three irrigations after sowing expressed a significant increases in these traits compared to those received two irrigations (362.9, 351.5 and 319.8 spikes/m^2 for five, three and two irrigations, respectively), and (43.5, 43.2 and 41.2 kernels / spike for five, three and two irrigations respectively). It can be concluded that the increases in available water may caused the increases in number of tillers / m^2 and number of kernels /spike. These results agree with those obtained by Ahmed *et al* (1998) and Kimurto *et al* (2003).

With regard to 1000-kernel weight, the results indicated that plants received five irrigations exhibited a significant increase in 1000-kernel weight compared with two or three irrigations. The lowest by two irrigations (46.2, 44.2 and 40.6 gram /1000 kernel for five, three and two irrigations, respectively). Water deficiency during grain filling period wheat plants was at maximum use of water and any stress conditions through this stage caused reduction in 1000-kernel weight. Similar results were obtained by Bhunia *et al* (2000). On the other hand El-Monoufi and Harb (1994) reported that under stress conditions grain weight was increased. Gadoury and Hess (2002) showed no effect on 1000-kernel weight under three irrigation treatments.

Grain yield (t/ha) was found to be appreciably influenced by the application of water regime treatments in the combined analysis. Wheat plants received five irrigations had significantly outyielded those received two or three irrigations. Such increase in grain yield was logically due to the achieved increase in its components. In addition, increasing number of irrigations (full irrigation) decreased the osmotic pressure of soil solution and consequently increased water and minerals absorption by growing wheat plants. This finding agrees with those obtained by Abo-Shetaia and Abd El-Gawad (1995), Ghandorah *et al* (1997), Koraiem *et al* (1997), Chandra *et al* (1999), and Bhunia *et al* (2000).

The results indicated that a significant increase in straw and biological yields (t/ha) were increased by increasing the amount of available water in the soil, also, there was a progressive and consistent significant increase in straw yield by increasing number of irrigations from two, three to five irrigations, respectively. The highest straw and biological yields (13.0 and 19.43 t/ha) were obtained from plants received five irrigations. The highest straw yield (t/ha), in fact, is the out product of its main components, i.e., plant height, stem thickness and number of tillers. Any increase in one or more of such components without decrease in the others will lead to an increase in straw yield. The obtained results clearly reflected the great effect of water deficiency on the mean performances of all the studied traits. Generally, plants received five irrigations expressed the highest mean values. A gradual depression in mean values parallel to the decrease in amount of available water in the soil was detected.

B. Effect of nitrogen fertilizer levels:

Means of yield and its components as affected by nitrogen fertilizer levels are presented in Table 4. Highest number of spikes/m^2 (366.7) were obtained by increasing nitrogen fertilizer level up to 216 Kg N/ha compared with plants received 144 Kg N/ha or 72 Kg N/ha. These results agree with those obtained by Moustafa *et al.* (1997).

Regarding the influence of nitrogen fertilizer levels on number of kernels /spike, the results indicated that plants received nitrogen fertilizer level of 216 Kg N/ha expressed a significant increase in number of kernels /spike (44.43) compared with those received fertilizer levels 144 or 72 Kg N/ha (42.95 and 40.70), respectively. It can be concluded that the decrease in number of kernels / spike detected by reducing the nitrogen fertilizer levels reflected the probable effect of N deficiency on spike fertility. These results agree with those obtained by Moustafa *et al* (1997), Abd El-Ghani and Awad (1999) who reported that all grain yield components were decreased with decreasing nitrogen fertilizer levels. The results in Table 4 showed that nitrogen fertilizer levels had highly significant effect on 1000-kernel weight. The highest significant value of this trait (46.1g) was achieved by fertilizing wheat plants with 216 Kg N/ha and this was followed by (43.9g) when wheat plants received 144 Kg N/ha.

Table 4: **Means of number of spikes / m^2, number of kernels /spike, 1000- kernel weight (g), straw yield (t/ha), grain yield (t/ha), and biological yield (t/ha) as affected by nitrogen fertilizer levels over irrigation treatments, wheat genotypes and seasons (2002/2003 and 2003/2004).**

Nitrogen fertilizer levels	Number of spikes /m^2	Number of kernels / spike	1000- kernel weight (g)	Straw yield (t/ha)	Grain yield (t /ha)	Biological yield (t/ha)	Harvest index
N1	323.9 c	40.7 c	41.1 c	10.6 c	5.3 c	15.9 c	0.33 a
N2	343.6 b	42.9 b	43.9 b	12.1 b	5.9 b	18.1 b	0.33 a
N3	366.7 a	44.4 a	46.1 a	13.2 a	6.5 a	19.8 a	0.33 a

N1= 72 Kg N/ha, N2= 144 Kg N/ha, N3= 216 Kg N/ha

Means with the same letter are not significantly different.

Concerning the response of straw yield to nitrogen fertilizer levels, results presented in Table 4 indicated that a significant increase in this trait. Maximum straw yield / ha was exerted by increasing the amount of nitrogen fertilizer. The highest straw yield (13.2 t/ha) was obtained from plants received 216 Kg N/ha, while the lowest one was obtained by plants received fertilizer level of N2 and N1, respectively (12.17 and 10.63 t/ha). Similar results were reported by Moustafa *et al* (1997) and Allam (2003).

Grain yield (t/ha) was found to be appreciably influenced by the application of nitrogen fertilizer levels in the combined analysis. Wheat plants fertilized with 216 Kg N/ha significantly outyielded those fertilized by N2 or N1, respectively. The reduction percentages in grain yield reached 8.84% and 19.2% (from 6.56 to 5.98 and 5.30 t/ha) as a result of decreasing nitrogen fertilizer levels from 216 to 144 and 72 Kg N/ha. The obtained results could be attributed to the role of nitrogen in spike fertility and grain development. These results are in harmony with those reported by Moustafa *et al* (1997), Abd El-Ghani and Awad (1999), Patil *et al* (2000) and Allam (2003). For biological yield, results presented in Table 4 indicated that a significant increase in this trait, highest biological yield /ha exerted by increasing the amount of nitrogen fertilizer. The highest biological yield (19.8 t/ha) was obtained from plants received fertilizer 216 Kg N /ha, while the lowest ones were obtained by the plants received fertilizer 144 Kg N/ha and

72 Kg N/ha, which were 18.15 and 15.93 t/ha, respectively. Similar results were reported by Moustafa *et al* (1997), Ryan *et al* (1997), and Allam (2002).

C. Wheat genotypes differences:-

Mean performances of the investigated wheat genotypes in the combined analysis are presented in Table 5. With regard to number of spikes/m^2, data indicated that there were significant differences between wheat genotypes. The results in this Table clear that the genotype No. 6 (ICW92) had the highest number of spikes / m^2 (354.7) but insignificant with genotypes No. 1 (Bhrikuti), No. 2 (CMBW90), No. 4 (CM103448), No. 5 (CM85836), and No. 8 (Giza 168), while the lowest number of spikes / m^2 obtained by genotypes No.7 (Gemmiza 7) and No. 3 (CM103564) (302.4 and 339.7, respectively).

Table 5: Means of number of spikes / m^2, number of kernels /spike, 1000- kernel weight (g), straw yield t/ha, grain yield t/ha, biological yield t/ha, and as affected by wheat genotypes over nitrogen fertilizer levels and irrigation treatments for 2002 / 2003, 2003/ 2004 seasons and their combined.

Genotypes	Number of spikes/ m^2	Number of kernels/ spike	1000-kernels weight	Straw yield (t/ha)	Grain yield (t/ha)	Biological yield (t/ha)	Harvest index
1 Bhrikuti	349.7 ab	44.6 a	45.6 a	12.7 a	6.1 a	18.9 a	0.32 bcd
2 CMBW90	359.6 a	42.1 b	44.4 c	12.5 ab	5.9 b	18.5 ab	0.32 d
3 CM103564	339.6 b	40.1 c	41.7 d	12.0bcd	5.8 cd	17.9 dc	0.32 cd
4 CM103448	349.5ab	41.7 b	41.1 d	11.5 e	5.7 d	17.3 e	0.33 bcd
5 CM 85836	352.1 a	44.2 a	44.8 bc	12.2 bc	6.1 a	18.3 bc	0.33 bc
6 ICW 92	354.7 a	43.7 a	45.2 ab	11.6 de	6.1 a	17.7 de	0.34 a
7 Gemmiza 7	302.4 c	42.5 b	45.2 ab	11.5 e	5.7 d	17.3 e	0.33 bcd
8 Giza 168	349.7 ab	42.4 b	41.3 d	11.8 de	5.9 bc	17.8 de	0.33 b

Means with the same letter are not significantly different.

The difference between wheat genotypes concerning number of kernels / spike reached the significance level in the combined analysis and the mean values of this trait are presented in Table 5. The results showed that genotype No. 1 (BHRIKUTI), produced the highest number of kernels /spike (44.6) over all other genotypes but differenced were insignificant with genotypes 5 (CM85836) and 6 (ICW92). On contrast, the genotypes No. 3 (CM103564) recorded the lowest number of kernels / spike (40.1). For 1000-kernel weight, it is observed from Table (5) that wheat genotypes had highly significant effect on this trait. Genotype No. 1 (BHRIKUTI) gave the highest mean value (45.63g) followed by genotype No. 7 (GEMMIZA 7) and No. 6 (ICW92). While the lowest mean value was recorded by genotype No. 4 (CM103448) (41.18g).

Grain yield (t/ha) in the combined analysis was found to be appreciably influenced by wheat genotypes. It is showed that genotypes No. 1 (Bhrikuti), No. 5 (CM85836) and No. 6 (ICW92) produced higher grain yield

(6.17, 6.12 and 6.11 t/ha respectively) than other genotypes. While genotypes No. 7 (Gemmiza 7) and No. 4 (CM103448) produced lowest grain yield (5.75 t/ha). This might be attributed to increases in yield components such as number of spikes / m^2, number of kernels /spike, 1000-kernel weight. These results agree with the findings of Meneses and Ivan (1992), Gouis and Pluchard (1996), Ahmed *et al* (1998), and Timsina *et al* (1998), who concluded that the differences among genotypes were observed for grain yield and its components. The differences between wheat genotypes in straw and biological yields were found to be significant in the combined analysis. It was noticed that, in Table 5. Genotype No. 1 (BHRIKUTI), recorded the highest straw and biological yields /ha (12.75 and 18.92 t/ha). On contrast, genotype No. 7 (GEMMIZA 7) produced lowest straw yield (11.57 t/ha) and the genotypes No. 4 (CM103448) gave the lowest biological yield (17.31 t/ha).

For harvest index, the highest values (0.34) was obtained by genotype No.6 (ICW92) and the lowest ones (0.32) by genotype No.3 (CM103564). It could be concluded that these variations in the results are quite expected since the tested wheat genotypes had some differences in their genetic structure and their responses to environmental conditions.

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تأثير التسميد النتروجينى والرى على المحصول ومكوناته لبعض أصناف قمح الخبز

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أقيمت تجربتان حقليتان بمزرعة محطة البحوث الزراعية بالنوبارية – مركز البحوث الزراعية خلال الموسمين الزراعيين ٢٠٠٢ /٢٠٠٣ و ٢٠٠٣ / ٢٠٠٤ وكان التصميم المستخدم هو القطع المنشقة مرتين حيث وضعت معاملات الرى والتى شملت ثلاث معاملات (الرى مرتين ، ثلاثة ، خمس ريات) فى القطع الرئيسية ومعدلات التسميد الأزوتى ٧٢ ، ١٤٤ ، ٢١٦ كجم نتروجين للهكتار) فى القطع المنشقة وسلالات قمح الخبز (٨ تراكيب وراثية) فى القطع التحت شقية. ويمكن تلخيص أهم النتائج المتحصل عليها كما يلى:

١- أشارت النتائج إلى أن الرى ٥ ريات سجل أعلى القيم للمحصول ومكوناتة ولم يكن هناك أختلاف معنوى بالرى ريتان أو ثلاث ريات على عدد السنابل بالمتر المربع وعدد الحبوب بالسنبلة نسبة النقص فى المحصول للحبوب إلى ١٧,٥٧ % ، ٤,٨٢ % مقارنة بالرى ٥ ريات على الترتيب.

٢- أظهرت النتائج أن زيادة معدل التسمد النتروجينى حتى ٢١٦ كجم نتروجين للهكتار أدت إلى زيادة معنوية فى عدد السنابل بالمتر المربع وعدد حبوب السنبلة ومحصول القش والحبوب والمحصول البيولوجى للهكتار.

٣- أظهرت النتائج أن السلالة رقم ١ ، ورقم ٥ ، ورقم ٦ سجلت أعلى المتوسطات لمحصول الحبوب / للهكتار وعدد الحبوب بالسنبلة ووزن الألف حبة بدون فروق معنوية .

توصى هذه الدراسة برى القمح ٥ ريات والتسميد بمعدل ٢١٦ كجم نتروجين للهكتار وذلك للحصول على أعلى إنتاجية تحت ظروف الأراضى حديثة الإستصلاح.