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USING CHLOROPHYL METER FOR PREDICTING WHEAT NITROGEN REQUIREMENTS

BY

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ABSTRACT

Two field experiments were conducted at the Agric. Res. Centre Station, Giza Governorate, Egypt during 2006/2007 and 2007 /2008 seasons. Each experiment included three bread wheat cultivars (Sakha-94, Giza-168 and Gemmiza-9) and five N fertilization treatments (0, 40, 80 120 kg N/fed. and conditional N treatment). Results revealed that Gemmiza-9 cultivar achieved the highest increases in yield and its attributes, weight of 1000 grains and wet and dry gluten %. Also, this cultivar was the most efficient for producing higher grain yield at low nitrogen rate and was the most responsive to the increase in N fertilizer rates (ER). Adding 120 kg N/fed. recorded the maximum values of yield and its attributes. N recommended rate came in the second order statistically equalizing with conditional N treatment for grain yield. The conditional N treatment, 80 and 120 kg N/fed. (for protein %) as well as conditional N treatment and 80 kg N/fed. (for protein yield, wet gluten % and dry gluten %) were substantially equaled. Moreover, conditional N treatment achieved the highest values of AE and RF.

Key words: Wheat cultivars, nitrogen use efficiency, chlorophyll meter

INTRODUCTION

Adding nitrogen fertilizers is important for increasing the productivity of wheat plant, the excess of its doses may cause environmental hazards. Hence, the balance between the possible maximum productivity (by supplying N) and minimizing pollution of environment (from excessive N application) is a goal to be reached. SPAD or chlorophyll meter is a dynamic, simple and diagnostic tool that measures greenness or relative chlorophyll content of leaves (Kariya *et al.*, 1982). SPAD readings positively related to chlorophyll levels in plant tissue which highly correlated with leaf N content in wheat (Singh *et al.*, 2002 and Balasubramanian *et al.*, 2003). Moreover, leaf area-based N concentration has a unique linear relationship with SPAD values of wheat at all growth stages (Uddling *et al.*, 2007). Such relation indicates the suitability of SPAD meter to assess crop N status and determine the plant need for additional N fertilizer (Peng *et al.*, 1996 and Balasubramanian *et al.*, 1999). In this concern, Singh *et al.* (2002) showed that plant need-based N management through chlorophyll meter reduced N requirement from 12.5-25 %, relative to typical practices of growers, with no loss in yield. On the other hand, varietal differences can greatly affect the SPAD meter reading as some wheat cultivars are greener than other.

Therefore, the objective of the present investigation was to recognize the validity of using SPAD meter to assess crop N status and determine adequate N need for some wheat cultivars.

MATERIALS AND METHODS

Two field experiments were conducted at the Agric. Res. Station, Agric. Res. Centre, Giza Governorate, Egypt during 2006/ 2007 and 2007 /2008 seasons. Each experiment included 15 treatments, which were the combinations of three bread wheat cultivars namely Sakha-94, Giza-168 and Gemmiza-9 (obtained from Wheat Dept., Agric. Res. Centre at Giza) as well as five N fertilization treatments, i.e. 0, 40, 80 and 120 kg N/fed., in addition to conditional N treatment. The latter treatment was applied by calculating nitrogen sufficiency index (NSI) as suggested by Murdock *et al.* (2004) based on chlorophyll status of the uppermost fully expanded leaf in relation to that of sufficient N rate treatment (120 kg N/fed.) using chlorophyll meter (**SPAD** -502, Minolta) **where:**

NSI = SPAD value of conditional N treatment /SPAD value of sufficient N rate treatment x 100

Ten chlorophyll readings were measured periodically just before irrigation from the middle of the uppermost fully expanded leaf of ten guarded plants from each plot in four replicates, i.e. 40 readings were collected from each treatment, then the average was computed. When NSI was less than 95 %, it indicates N deficiency and additional N should be added using the following equation:

$$N = 6 + (7 \times D)$$

Where:

N = (Pound N/acre) needed for optimum growth (transferred into kg/fed.),

D= Difference between average chlorophyll readings from the field (conditional N treatment) and that from the reference area received high N rate (sufficient N rate).

Conditional N treatment was applied by adding initial rate of 20 % of the recommended N rate (80 kg N/fed.) at planting. Then optimum N requirements were added based on NSI, at elongation and early flowering stages, this accompanied the fixed timing practice (35 and 65 days after sowing, respectively). N amount of the conditional N treatment according to the difference between it and that of sufficient N rate was presented in Table (1).

Table (1): N amount of the conditional N treatment according to the difference between it and that of sufficient N rate.

Cultivar	N initial dose (kg/fed.)	Elongation stage		Flowering stage		Total N applied (kg/fed.)
		D	N (kg/fed.)	D	N (kg/fed.)	
Sakha-94	16	1.45	17.6	2.40	24.8	58.4
Giza-168	16	2.10	22.7	2.20	23.2	61.9
Gemmiza-9	16	1.60	18.9	2.30	24.3	59.2
Mean						59.8

D = Difference between average chlorophyll readings from the field (conditional N treatment) and that of from the reference area received high N rate (sufficient N rate).

The physical and chemical characteristics of soil before planting was determined according to Jackson (1973) and revealed that the soil was clay containing 62.2 ppm total N with pH 7.6.

Nitrogen fertilizer was applied as urea (46.5 % N) into three portions equivalent to 20, 40 and 40 % of total N amount of each N rate treatment (except 0 and conditional N treatments) at planting, elongation and flowering stages, respectively.

The experimental design was strip plot design in four replicates, where wheat cultivars were arranged in vertical strips and N fertilization rates were allocated in the horizontal ones. The experimental unit area was 10.5 m^2 consisting of 15 rows each of 3.5 m in length and 20 cm apart. Planting date was 25th November in the two growing seasons. All the recommended agricultural practices were applied except the studied factors.

Data recorded:

Yield and its attributes:

At harvest, a sample of plants from 0.1 m^2 was randomly chosen from each plot of three replicates to measure spikes No./m^2, spike length, spikes weight./m^2, spikelets No./ spike and grains No./spike. Biological and grain yields/fed. were calculated from whole plants of each plot.

Grain quality:

Weight of 1000 grains was estimated and samples of 100 g of grains or straw from three replicates of each treatment were grinned into fine powder and dried at 70°C. Then, grain and straw N % were determined using micro-Kjeldahl apparatus according to AOAC (1995). Moreover, grain crude protein content was calculated by multiplying grain N % by 5.7. Also, wet and dry gluten as percentages of dry grains and hydration value as percentage of dry gluten were estimated (Pleshkof, 1976).

Nitrogen physiological parameters:

Grain and straw N uptake kg/fed. were computed by multiplying grain and straw N % with grain and straw yields/fed., respectively, then total N uptake (grain + straw N uptake) was calculated. Moreover, nitrogen physiological parameters including agronomic efficiency (AE), apparent recovery fraction (RF), N utilization efficiency (NUE) and N harvest index (NHI) were calculated according to Delogu *et al.* (1998) using the following equations:

1- AE = GY at N treatment – GY at zero N /Applied N at N treatment (kg/fed.)
2- RF = TNU at N treatment –TNU at zero N /Applied N at N treatment (kg/fed.) x 100
3- NUE = GY at N treatment /TNU at N treatment
4- NHI = GN at N treatment /TNU at N treatment x 100

Where:

TNU = Total nitrogen uptake (kg/fed.),
GY = Grain yield (kg/fed.).
GN = Grain nitrogen uptake (kg/fed.).

Grain yield response index:

Grain yield response index (GYRI) was determined for each cultivar, according to Fageria and Barbosa Filho (1981) using the following equation:

GYRI = Grain yield under high N level – Grain yield under low N level/High N level – Low N level

Where:

Low N level=0 kg/fed.,
High N level=80 kg/fed.

Statistical analysis:

The obtained data from each season were exposed to the proper statistical analysis of variance according to Gomez and Gomez (1984). The combined analysis of variance for the data of the two seasons was performed after testing the error homogeneity and LSD at 0.05 level of significance was used for the comparison between means.

RESULTS AND DISCUSSION

Yield and its attributes:

a- Cultivars:

Data in Table (2) reveal that all yield and its attributes of wheat substantially differed among the three studied cultivars, except spike length trait. Herein, Gemmiza-9 was the potent for achieving the highest increases in spike number and weight/m^2, number of spikelets and grains/spike as well as biological and grain yields/fed., but statistically leveled with Sakha-94 in spike number/m^2 and with Giza-168 in number of spikelets and grains/ spike. The discrepancy in yield and its attributes among wheat cultivars might be due to the genetic make-up reflecting on grain filling rate and translocation of biochemical assimilates from source to sink. Confirming results in this respect were cited by El-Habbal *et al.* (2000) and Hassan & GabAllah (2000)

b- N rates:

Available results in Table (2) show that wheat yield and its attributes (i.e., spike number/m^2, spike length, spike weight/m^2, number of spikelets and grains/spike as well as biological and grain yields/fed) significantly responded to N rates. As expected, such traits enhanced as N rates were increased from

0 up to 120 kg/fed. In this respect, adding 120 kg/fed. recorded the maximum values of the mentioned traits exceeding the other treatments. N recommended rate came in the second order statistically equalizing with conditional N treatment for grain yield. The increments in yield and its attributes of wheat with increasing N rates might be attributed to the effective role of N as an essential constituent of chlorophyll on dry matter accumulation. N fertilizer influences the production of carbohydrates by affecting the mean leaf area available to intercept solar radiation and absorb CO_2, promoting the efficiency of photosynthesis process. The improvements in wheat yield and its components under increasing N rates were obtained by David *et al.* (1999) and Sobh *et al.* (2000).

Table (2): Wheat yield and its attributes as affected by cultivars and N rates and their interaction

Treatment	Spikes No./m²	Spike length (cm)	Spikes weight (g./m²)	Spikelets No./spike	Grain No./spike	Yield (ton/fed.)	
						Biological	Grain
Cultivar							
Sakha-94	524.8	11.2	1.29	20.8	54.8	8.88	2.87
Giza-168	518.6	11.7	1.27	21.1	58.6	8.75	2.90
Gemmiza-9	529.3	11.7	1.30	21.6	58.7	8.97	3.02
LSD (0.05)	6.1	n.s	0.01	0.6	2.3	0.08	0.04
N rate (kg/fed.)							
0	438.2	10.4	1.01	19.6	51.0	6.56	2.41
40	483.7	11.1	1.14	20.2	54.0	7.92	2.68
59.8*	549.1	11.5	1.27	21.2	58.0	9.36	3.09
80	564.4	12.0	1.42	21.9	59.8	9.77	3.13
120	585.9	12.5	1.58	23.0	64.1	10.74	3.35
LSD (0.05)	11.7	0.2	0.01	0.5	1.3	0.10	0.05
Cultivar x N rate (kg/fed.)							
Sakha-94							
0	442.2	10.1	1.03	19.2	48.0	6.39	2.33
40	478.7	10.9	1.14	19.9	51.1	8.02	2.63
58.4*	546.2	11.1	1.26	20.7	55.1	9.42	3.02
80	562.5	11.6	1.40	21.5	57.2	9.69	3.07
120	594.6	11.9	1.59	22.6	62.5	10.88	3.30
Giza-168							
0	425.6	10.4	0.98	19.6	51.8	6.49	2.40
40	475.6	11.3	1.11	20.0	54.8	7.69	2.70
61.9*	553.3	11.7	1.27	21.1	59.9	9.30	3.04
80	563.1	12.2	1.42	21.7	61.5	9.71	3.08
120	575.6	12.9	1.55	22.9	65.0	10.58	3.32
Gemmiza-9							
0	446.8	10.6	1.03	19.9	53.1	6.79	2.50
40	496.8	11.1	1.16	20.5	55.9	8.04	2.71
59.2*	547.8	11.7	1.28	21.6	59.1	9.35	3.22
80	567.7	12.2	1.42	22.3	60.6	9.91	3.25
120	587.5	12.6	1.58	23.4	64.7	10.77	3.44
LSD (0.05)	14.9	0.3	0.02	0.4	1.8	0.19	0.06

* Conditional N treatment

c- Cultivars x N rates:

Distinctive effect of the interaction between wheat cultivars and N rates on yield and its attributes was obtained (Table, 2). In this respect, the studied cultivars were not behaving the same performance under various

N rates for yield and its attributes. Under the application of 120 kg/fed., number and weight of spike/m^2 and biological yield with Sakha-94; spike length and grains number/spike with Giza-168 as well as spikelets No. and grain yield with Gemmiza-9 recorded the maximum values. Adding 80 kg N/fed came in the descending order in this respect with the same previous arrangement of cultivars and markedly leveled with those of conditional N treatment for grain yield. Although adding 120 kg N/fed. surpassed conditional N treatment in grain yield by 6.8, 9.2 and 9.3 %, but the reductions in N applied in the lattar treatment were 50.7, 48.4 and 51.3 % with Gemmiza-9, Giza-168 and Sakha-94, respectively. This result is promising regarding lowering both costs and environmental hazards.

Grain quality:

a- Cultivars:

Grain quality traits, i.e. weight of 1000 grains, wet gluten %, dry gluten % and hydration value markedly varied among wheat cultivars, while protein % and yield were not affected (Table, 3). In this concern, Gemmiza-9 possessed the maximum increases surpassing Sakha-94 and Giza-168 by 2.4 and 3.4 % in weight of 1000 grains; 14.7 and 6.8 % in wet gluten % as well as 11.2 and 6.4 % in dry gluten %, respectively. The differences in such grain quality traits are essential factors that led to improve the rheological properties of obtained dough and subsequently bread quality. This observation is corroborated with the results of Teama *et al* (1993) and El-Nagar (2003). Moreover, the difference between Gemmiza-9 and Giza-168 did not reach the 5 % level of significance for hydration value.

b- N rates:

Remarkable effect of N rates on grain quality of wheat was obtained (Table, 3). Application of 120 kg N/fed. was the efficient practice for promoting weight of 1000 grains, protein % and yield, wet gluten % and dry gluten %. Contrarily, the maximal hydration value was produced from unfertilized plots. Moreover, the conditional N treatment, 80 and 120 kg N/fed. (for protein %) as well as conditional N treatment and 80 kg N/fed. (for protein yield, wet gluten % and dry gluten %) were substantially equaled. Higher nutritional value of wheat grains due to increasing N rate could be ascribed to increase amino acids content, increasing protein % and yield as well as wet and dry gluten %. This observation agrees with that found by Kumar (1985) and Sharma (1987).

c- Cultivars x N rates:

All grain quality properties were significantly influenced by the interaction between wheat cultivars and N rates (Table, 3). Gemmiza-9 x 120 kg N/fed. possessed the highest values of weight of 1000 grains and wet and dry gluten %. While, Giza168 x 120 kg N/fed. was the best combination for enhancing protein % and yield. Contrariwise, in the unfertilized plots, Giza-168 gave the maximum hydration value.

With each cultivar, the treatment of 80 kg N/fed. remained in the second order in this respect and also statistically at par with conditional N treatment for all grain quality traits, except wet gluten % of Giza-168 grains.

N physiological parameters:

For exploring the effective treatments in N uptake, translocation and utilization of wheat plant, grain, straw and total N uptake were estimated (Table, 3), then AE, RF, NUE and NHI were computed as shown in Figures (1, 2 and 3).

There is no significant difference among wheat cultivars in grain, straw and total N uptake amount. Also, such difference was slight for AE, RF, NUE and NHI (Fig, 1).

Grain, straw and total N uptake were significantly affected by N rate (Table, 3). It was found that total amount of N uptake and its fractions in grains and straw were increased as N rates increased. With the exception of sufficient N rate of 120 kg/fed, both of 80 kg N/fed. and conditional N treatments were the effective for recording the highest total amount of N and its fraction in grains and straw without significant difference between them in this respect.

Table (3): Wheat grain quality and N uptake as affected by cultivars and N rates and their interaction

Treatment	Weight of 1000-grain (g)	Grain protein		Gluten %		Hydration value %	N uptake (kg/fed.)		
		%	Yield (kg/fed.)	Wet	Dry		Grain	Straw	Total
Cultivar									
Sakha-94	41.5	13.45	390.1	32.6	13.6	139.0	68.4	19.5	87.7
Giza-168	41.1	13.85	407.2	35.0	14.0	151.1	71.4	19.5	90.4
Gemmiza-9	42.5	13.80	420.5	37.4	14.9	150.4	73.8	18.6	92.4
LSD (0.05)	0.5	n.s	n.s	0.5	0.4	7.7	n.s	n.s	n.s
N rate (kg/fed.)									
0	38.0	11.95	288.3	28.7	11.3	153.3	50.6	8.3	58.9
40	39.9	12.90	345.8	31.3	12.5	149.1	60.7	13.1	73.8
59.8*	42.0	14.26	441.3	36.3	14.7	146.9	77.4	22.0	99.4
80	43.6	14.06	440.7	37.1	15.0	145.8	77.3	23.1	100.4
120	44.9	15.31	513.6	41.5	17.3	139.2	90.1	29.5	119.6
LSD (0.05)	0.5	1.42	40.7	1.4	0.7	8.5	7.3	6.8	12.8
Cultivar x N rate (kg/fed.)									
Sakha-94									
0	37.9	11.40	265.6	26.4	10.6	149.0	46.6	8.1	54.7
40	39.7	12.80	336.6	28.8	12.4	132.3	59.1	13.5	72.6
58.4*	42.0	14.55	439.4	35.0	14.6	139.6	77.1	22.5	99.6
80	43.4	13.70	420.6	33.6	14.2	136.6	73.8	23.1	96.9
120	44.6	14.80	488.4	39.0	16.4	137.9	85.7	30.3	116.0
Giza-168									
0	37.0	11.95	286.8	28.6	10.8	165.0	50.3	8.3	58.6
40	39.2	12.80	345.6	29.6	11.8	150.9	60.6	15.1	75.7
61.9*	41.5	13.95	424.0	36.2	14.4	151.7	74.4	22.0	96.4
80	43.0	14.55	448.1	38.8	15.6	148.8	78.6	23.2	101.8
120	44.4	16.00	531.2	41.6	17.4	139.0	93.2	29.0	122.2
Gemmiza-9									
0	39.0	12.50	312.5	31.0	12.6	146.0	54.8	8.6	63.4
40	40.8	13.10	355.0	35.4	13.4	164.2	62.3	10.7	73.0
59.2*	42.5	14.30	460.5	37.8	15.0	149.3	80.8	21.6	102.4
80	44.2	13.95	453.4	38.8	15.4	151.9	79.5	23.1	102.6
120	45.8	15.15	521.2	43.8	18.2	140.7	91.4	29.3	120.7
LSD (0.05)	0.9	1.59	45.7	1.6	1.3	20.2	8.1	8.8	14.6

* Conditional N treatment

Moreover, conditional N treatment achieved the highest values of AE and RF (Fig, 2). This refers to that applying one N unit through such treatment showed increases in grain yield and total N uptake by 11.2 kg/fed. and 66.9 % of AE and RF, respectively. On the contrary, NUE and NHI were decreased as N rates increased, where such two parameters recorded the maximal values with the unfertilized treatment and the minimal ones at the rate of 120 kg/fed.

There is a considerable effect of the interaction between wheat cultivars and N rates on grain, straw and total N uptake (Table, 3). However, the aforementioned traits were enhanced as N rates increased for each cultivar. Application of N fertilizer at a rate of 80 kg/fed. (as a recommended practice) or using conditional N treatment (depending on chlorophyll meter) were statistically leveled in their effects on grain, straw and total N uptake. This was true with the three studied cultivars.

The interaction of Gemmiza-9 x conditional N treatment recorded the highest values of AE and RF, while the maximum values of NUE and NHI were observed in the unfertilized plots with Sakha-94 and with Gemmiza-9, respectively (Fig, 3).

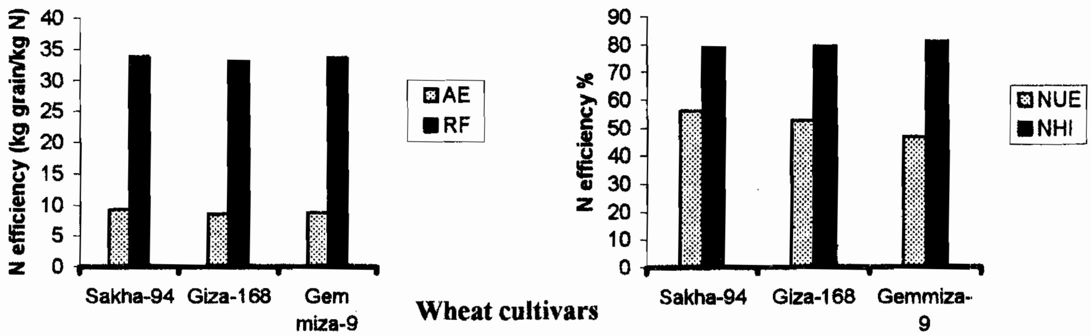

Fig (1): Differences among wheat cultivars in agronomic efficiency (AE), apparent recovery fraction (RF), N utilization efficiency (NUE) and N harvest index (NHI).

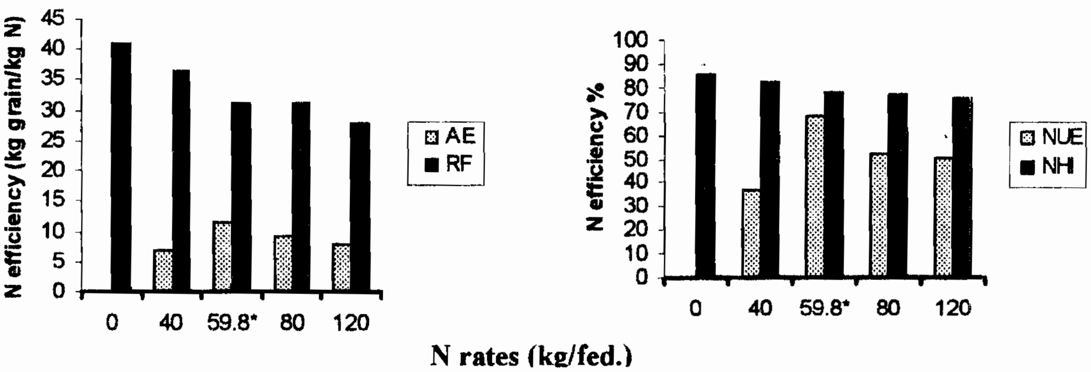

Fig (2): Effect of N rates on agronomic efficiency (AE), apparent recovery fraction (RF), N utilization efficiency (NUE) and N harvest index (NHI) in wheat.
*** Conditional N treatment**

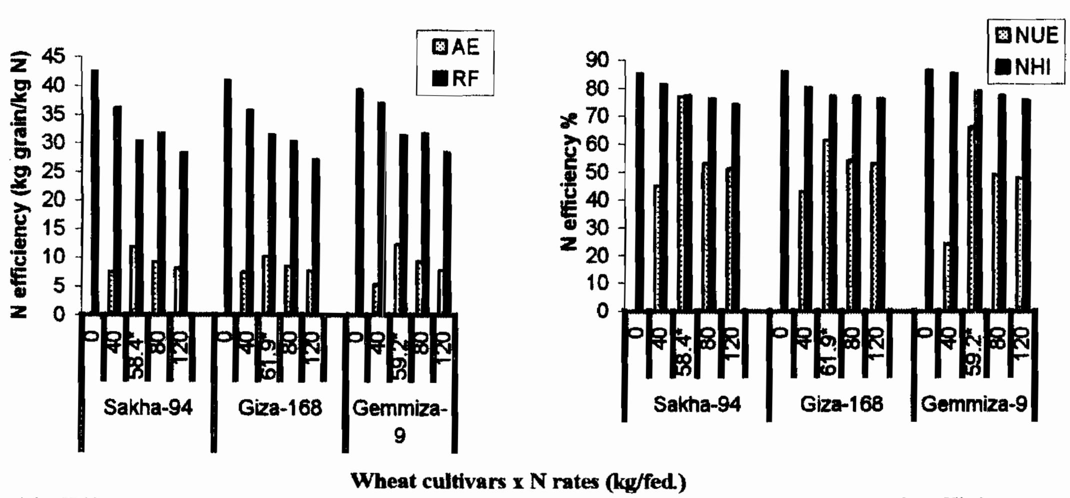

Fig (3): Effect of the interaction between wheat cultivars and N rates on agronomic efficiency (AE), apparent recovery fraction (RF), N utilization efficiency (NUE) and N harvest index (NHI).
*** Conditional N treatment**

Grain yield response index (GYRI):

Grain yield response index (GYRI) was calculated at 0 and 80 N kg/fed as low and high N levels, respectively. GYRI is an indication to the efficient of wheat cultivars for producing higher grain yield at low nitrogen rate and their response to increase N fertilizer rates. Accordingly, it is possible to classify wheat cultivars into four groups. (i) efficient and responsive (ER), that produce high grain yield at low as well as high rates of N fertilizer; (ii) efficient and not responsive (ENR), that produce high grain yield at low N rate with lower response to increase N fertilizer than ER. (iii) not efficient but responsive (NER), that had low grain yield with response to increase N fertilizer as well as (iv) neither efficient nor responsive (NENR), that had low grain yield with low response to increase N fertilizer. Apropos, Gemmoza-9 belongs to ER group being exceeded the averages of grain yield at zero rate and GYRI (Fig. 4). While, Sakha-94 is NER being gave lower grain yield at zero N rate and higher GYRI than the averages. Giza-168 was NENR, where both grain yield at zero N rate and GYRI were lower than the averages.

According to GYRI parameter, results indicated clearly considerable differences among wheat cultivars for absorbing and utilizing N from deficient soils. Gemmiza-9 followed by Sakha-94 exhibited less reduction in yield under low N fertilizer level indicating the significance of focusing on these two cultivars as an efficient gene pool to incorporate the adaptation for low N availability (in the soil) and with high efficiency in the utilization of N fertilizer applied. It should be concluded that N level in the soil could be manipulated together with the genetic diversity of the crop as a breeding tool for wheat cultivars development through improving N uptake and/or utilization efficiency. These findings are in good agreement with those obtained by Abd ElGhani and Awad (1999)

Eventually, it could be interpreted that SPAD meter can quickly and reliably assess N status based on leaf chlorophyll content and determining N requirements in wheat.

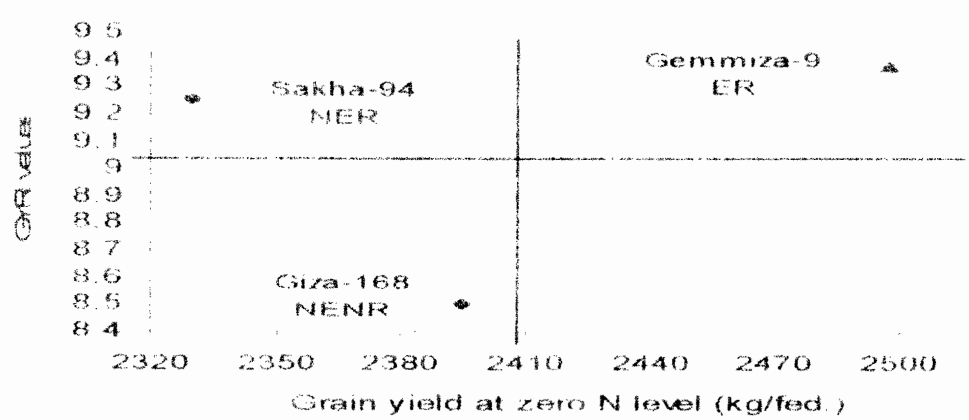

Fig. (4): Grain yield response index (GYRI) of wheat cultivars (Sakha-94, Giza-168 and Gemmiza-9).
ER, efficient and responsive; NER, not efficient but responsive; NENR, neither efficient nor responsive.

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استخدام جهاز الكلوروفيل للتنبؤ بالاحتياجات النيتروجينية للقمح

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أجريت تجربتان حقليتان بمحطة مركز البحوث الزراعية- الجيزة- مصر. خلال موسمى ٢٠٠٦/٢٠٠٧-٢٠٠٧/٢٠٠٨. تضمنت كل تجربة ثلاثة أصناف من قمح الخبز (سخا ٩٤، جيزة ١٦٨، جميزة ٩) و خمسة معاملات من التسميد النيتروجينى (صفر، ٤٠، ٨٠، ١٢٠، بالاضافة الى معاملة نيتروجين تطبق وفقا لقراءة جهاز الكلوروفيل conditional N treatment). أظهرت النتائج أن الصنف جميزة ٩ حقق أعلى زيادة فى كمية المحصول و مكوناته، و لكن تساوى احصائيا مع سخا ٩٤ فى عدد السنابل/م٢ و مع جيزة ١٦٨ فى عدد السنيبلات و الحبوب/سنبلة. سجلت معاملة ١٢٠ كجم ن/فدان أكبر القيم للمحصول و مكوناته، و جاءت معاملة النيتروجين الموصى بها (٨٠ كجم ن/فدان) فى المرتبة الثانية متساوية معنويا مع conditional N treatment فى تأثيرهما على كمية محصول الحبوب. أحرز الصنف جميزة ٩ أقصى زيادة فى وزن ال ١٠٠٠ حبة و النسبة المئوية للجلوتين الرطب و الجاف. تساوت احصائيا معاملات conditional N treatment و ٨٠ و ١٢٠ كجم ن/فدان فى تأثيرها على النسبة المئوية لبروتين الحبوب، كما تساوت معنويا معاملتا conditional N treatment و ٨٠ كجم ن/فدان فى تأثيرهما على محصول بروتين الحبوب و النسبة المئوية للجلوتين الرطب و الجاف. حققت معاملة conditional N treatment أعلى القيم فى كفاءة استخدام النيتروجين. بحساب دليل استجابة محصول الحبوب GYRI للتسميد النيتروجينى تبين أن الصنف جميزة ٩ هو الأكثر كفاءة فى انتاج محصول الحبوب تحت المستوى المنخفض من التسميد النيتروجينى مع استجابته العالية للتسميد المرتفع.كما أوضحت الدراسة أن الصنف جميزة ٩ وسخا ٩٤ أظهرا قدرة جينية للتعامل مع المحتوى المنخفض من النيتروجين مع أرتفاع الكفاءة فى استخدام النيتروجين المضاف مما يلزم المربى والمنتج بالتعاون لاستخدام التباينات الوراثية كأداة لتحسين أصناف القمح من خلال تحسين امتصاص أو/ و زيادة كفاءة استخدام النيتروجين.