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Response of Some Wheat Cultivars to Different Nitrogen Fertilizer Rates and their Relation to Rust Diseases

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APPLICATION of N- fertilizer could improve the performance of wheat cultivars and grain quality but is known to affect the level of rust diseases, with higher N correlated with increased disease severity. The present study was carried out during 2016/2017 and 2017/2018 growing seasons and aimed to determine the different responses of the tested wheat cultivars to nitrogen fertilizer rates, to define the best fertilizer rate for agricultural improvement and to determine rust severity in wheat cultivars. Study were also determined compromised five fertilizer rates, i.e. 0, 25, 50, 75 and 100kg N fed^{-1} and three wheat cultivars, i.e. Gemmeiza 11, Shandaweel 1 and Giza 168. Results showed that the interaction effect between nitrogen levels and wheat cultivars was significant for spikes m^{-2}, grains spike^{-1} and kernel weight. Gemmeiza 11 with 75kg N fed^{-1} achieved the highest 1000- kernel weight followed by Giza 168 then Shandaweel 1. For rust severity, Giza 168 and Shandaweel 1 were more resistant to rust diseases followed by Gemmeiza 11. Increased levels of N increased the severity of rust diseases during grain filling. Stripe and leaf rust decreased the yield of the rust-susceptible wheat cultivars. Analysis of agronomic data assured the expected outcomes of a positive association between N application and yield up to a certain level of N application. The study also approved that there are significant positive correlations between N rates and rust severity.

Keywords: Wheat, Rusts, Disease severity, Yield, N-fertilizer.

Introduction

Wheat (*Triticum aestivum* L.) is the most important crop provides about 37% of calories and 40% of the necessary protein within the human diet (Mujeeb et al., 2008). It will be necessary to increase cereal crops productivity to face the urgent demand result by increment of human population (Hirel & Lea, 2011).

Biotic and abiotic stresses are challenges in the way of achieving targeted production. Consequently, there is an urgent need to apply an integrated nutrient policy to avoid the nutrient deficiencies that affects negatively many crops. The judicious application of nitrogen (N) fertilizer is significant for increase yield production of wheat.

Nitrogen fertilizer (N) is expensive and its utilization varies from variety to other. Thus, it is important to detect the differential responses and yield traits of varieties under different nitrogen rates.

Yield reduction due to fungal disease attack is basically unpredictable and increase the using of chemicals for their control has impacts on environment and break pest resistance. Among wheat diseases that occur in Egypt, rust diseases, yellow or stripe, leaf rusts, caused by *Puccinia striiformis* f. sp. *tritici*, and *Puccinia triticina* f. sp. *tritici*, respectively. Eversmeyer & Kramer (2000) reported that the variable in rust species, climate changes and cultural process, united with cultivar resistance and altering in pathogen population, led to significant variation in the severity of rust epidemics each year. Wheat rusts cause threats to

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worldwide wheat production because their wide distribution, their capacity to form new strains and their capability to disseminate to long locations (Saari & Prescott, 1985; Kolmer, 2005).

Neumann et al. (2004) noted that increases the severity of stripe rust was noticed with using of nitrate-N, while decreases were noted with ammonium-N, whilst both nitrogen forms would have been prospective to increase wheat canopy size. This suggests that nitrogen impact on stripe rust that cause changes in the leaf as a substrate for pathogen growth, such as available leaf N in the apoplast or haustorial matrix. Also nitrogen concentration in leaf is noted to be more important for disease progress than wheat canopy size. Olesen et al. (2003 a,b) reported that the severity for powdery mildew and septoria leaf spot were noticed to increase with increasing leaf nitrogen concentration at flag leaf emergence.

Caviglia & Sadras (2001), Muurinen & Peltonen- Sainio (2006) found that nitrogen shortage can decrease evapotranspiration and water-use efficacy in wheat crop as well as decrease light interception and radiation-use efficacy. Gooding & Davies (1997) found undue N availability can increase the hazard of frost damage, lodging, air born disease and moisture squeeze within the plant, and can also retard crop maturation. Nitrogen nutrition is thought to be an important environmental agent effecting on the quantitative resistance of wheat crop to rust diseases and also high nitrogen is correlated with increasing of rust severity infection.

The present study was carried out to estimate the main responses and the interaction effects of different nitrogen fertilizer rates on the performance of three bread wheat cultivars and manifestation of rust severity on its productivity.

Materials and Methods

Two field experiments were conducted at Gharbyia Governorate, Gemmeiza Agricultural Research Station, Agricultural Research Center (ARC) during 2016/17 and 2017/18 growing seasons. The geographical position of the area is between N 23° 33’ Latitude, E 89° 44’ Longitude.

The statistical design of these experiments was a split plot design arrangement with four replications; where, the main plots were designated for the three bread wheat cultivars (Gemmeiza 11, Shandaweel 1 and Giza 168), while sub-plots were designated for the five nitrogen rates (control “0”, 25, 50, 75 and 100kg N fed^{-1}). These nitrogen rates were added based on each treatment in the form of urea (46% N) in both seasons as follows:first dose was 1\5 (one-fifth.) of the whole dose before the first (life) irrigation in 15 December. The second dose was 2/5 (two-fifth) of the whole dose before the second irrigation in 09 January. The third dose was 2/5 (two-fifth) of the whole dose before the third irrigation in 4 February.

Seed samples of three bread wheat cultivars were obtained from Wheat Research Department, Field Crops Research Institute, Agricultural Research Center, Giza, Egypt. The pedigree of the three studied cultivars was presented in Table 1.

The preceding crop was sunflower (*Helianthus annuus*) in the first season, while the preceding crop was maize (*Zea mays*) in the second one. The seeds were sown in November 15^{th} during the two seasons. The plot area was $10.5m^2$ (3.5m long, 3m wide and 20cm apart). Seeds were sown at a rate of 400seeds/ m^2 which was equal to the recommended seeding rate.

Soil samples (Vertisol, USDA soil taxonomy) were taken from different sites of the experimental site at 0-30cm depth from the soil surface, samples were dried (air drying) and grounded to pass through 2mm sieve, then well mixed. The procedure of preparation and measurements of the soil extract was done according to Black et al. (1965). The mechanical and chemical analysis of the soil in 2016/17and 2017/18seasons are shown in Table 2.

TABLE 1. Name and the pedigree of the three studied wheat cultivars.

Cultivars	Pedigree	Type
Gemmiza 11	Bow”s”/ Kvz // 7C / Seri 82 /3/ Giza 168 /sakha 61.	Spring
Shandaweel 1	SITE/MO/4/NAC//3*PVN/3/MiRLO	Spring
Giza 168	MRL/BUC/Seri.	Spring

TABLE 2. Physical and chemical properties of soil in the experimental site durring 2016/17 and 2017/18 seasons.

Characters		Seasons	
		2016/17	2017/18
A. Physical properties			
1.	Clayey %	54.44	52.2
2.	Silt %	29.77	30.4
3.	Sand %	15.79	17.4
Soil texture class		Clayey	Clayey
B. Chemical properties			
1.	pH	7.78	7.81
2.	EC dS/m*	0.96	0.94
3.	Organic matter %	2.49	2.62
4.	Available (N) ppm	95.64	133.35
5.	Available (P) ppm	29.2	36.16
6- Available (K) (ppm)		246.83	444.2

*EC: Electrical conductivity

A line of the wheat cultivar "Morocco" was sown to act as a rust spreader after every 3rd entry/cultivar that is highly susceptible to all the prevalent rust races of wheat and provides a substrate for rapid multiplication and distribution of rust inoculum. In order to maintain crop health and vigor, normal agronomic practices were applied as usual in the experimental area.

On the onset of February several plants of each spreader row were inoculated by injecting the uredosporesat 10^6/ml water (Rehman, 2006) into the stem with a hypodermal syringe (Zehner & Humphrey, 1929; Yakhtenfel'd, 1980). Spreader plants were also sprayed inoculum. Suspension was prepared by mixing fresh inoculum of (rust races) in distilled water in the form of uredospores (Obtained from Plant Pathology Research Institute, Giza, Egypt). Few drops of Tween-20 were also mixed in the uredospore suspension for better sticking on the surface of leaves and sprayed repeatedly on alternate days immediately after sun set for producing artificial epidemic conditions (Rowell, 1984). This is due to the fact that infection requires moisture.

The studied characters

Cultivars performance:

1. Days to heading: Days from sowing to 50% heading.
2. Days to maturity: Days from sowing to physiological maturity.
3. Plant height (cm): Measured from the soil surface to the top of the main stem's spike.
4. Number of spikes m^{-2}: Estimated by counting all spikes per square meter from each experimental unit.
5. Number of grains $spike^{-1}$: Average number of grains form randomly chosen 10 spikes.
6. Grain weight $spike^{-1}$: Recorded by weighting 10 main spikes and estimating the average.
7. 1000 kernel weight: Averages of three replications each contained 1000 grains from each cultivar, were weighted with a sensitive balance to the nearest gram.
8. Biological yield: Determined from harvested each sub-plot and then converted into ton fed^{-1}.
9. Grain yield: Determined from harvested each sub-plot then tied, threshed and grain yield was estimated in (Ardb fed^{-1}).
10. Straw yield: Determined from harvested each sub-plot then tied, threshed and straw yield was estimated in (ton fed^{-1}).
11. Germination percentage (G%): Calculated by counting only normal seedlings eight days after planting according to ISTA (1985).
12. Shoot lengths (cm): Measured as an average of ten normal seedlings eight days after sowing.
13. Seedlings dry weight (g): Determined using 10 normal seedlings dried in hot-air oven at 85°C for 12hr to obtain the seedling dry weight according to Krishnasamy & Seshu (1990).

Disease assessment

When rust symptoms were fully developed**,** nearly at the early dough stage (Large, 1954), the rust reaction data of adult plant scored as plant response and rust severity. Plant response expressed in five infection types (ITs) according to Johnston & Browder (1966). When the spreader plants were 50% infected, the rust data were scored four times for disease severity as percentage coverage of leaves with rust pustules using Cobb's scale modified by Peterson et al. (1948) at weekly intervals (Table 3).

Partial resistance (slow rusting) behavior was assessed through host response and epidemiological parameters estimates, i.e. average coefficient of infection (ACI) and area under disease progress curve (AUDPC).

ACI calculated according to Saari & Wilcoxson (1974) and Pathan & Park (2006)

ACI= *Values of rust severity* × *Response value*

Area under disease progress curves (AUDPC) is frequently used to combine multiple observations of disease progress into a single value and is a useful quantitative summary of disease intensity over time, to compare different responses of the tested genotypes and estimated by using the following equation which adopted by Pandey et al. (1989).

$$AUDPC= D\ [1/2(Y_1+Y_k)+Y_2+Y_3+\cdots Y_{k-1}]$$

where D= Days between reading, Y = First disease recording, Y_k= Last disease recording.

Statistical analysis

Data was subjected to analysis of variance and least significant difference (LSD) test at 0.05 level of significance was used to indicate mean comparison (Snedecor & Cochran, 1982).

Results and Discussion

Grain yield and biomass production

From agronomical perspective, the analysis of variance for agronomical traits showed significant variation among wheat cultivars for heading and maturity dates, grain weight, kernel weight, biological and straw yields fed^{-1}.

Regarding heading and maturity dates Giza 168 cultivar was the latest one, while Gemmeiza 11 was the earliest one and Shandaweel 1 came in the intermediate (Table 4). Gemmeiza 11 and Giza 168 cultivars wereat a par and both ranked the first and surpassed significantly Shandaweel 1 cultivar concerning to 1000 kernel weight, biological and straw yields fed^{-1}. On the other hand, Gemmeiza 11 cultivar ranked the first and scored the highest values of grain weight spike^{-1} followed by Giza 168, whereas Shandaweel 1 ranked the last and scored the lowest values as shown in Table 5.

The effect of nitrogen levels on all studied traits was significant in both seasons. The trend of data was clear and unified, whereas means of most traits were gradually increased with increasing limit of nitrogen from 0 up to 75kg N fed^{-1}, however no significant variation could be noticed with application of the highest N level (100kg N fed^{-1}) comparing to 75kg N fed^{-1} .

It is clear that, heading and maturity dates were delayed and plant height increased as the applied nitrogen increased until the highest N limit (100kg N fed^{-1}) without any significant differences with the N level 75kg N fed^{-1} for only plant height trait in both seasons. The availability of nitrogen increased vegetative growth due to its pivotal role in cell division, multiplication and root development which enhanced more leaf area resulting in higher photosynthesis rate, higher translocation of carbohydrates from source to growing points and thereby resulted in more dry matter accumulation, vegetative period and taller plants (Table 4).

TABLE 3. Adapted scale for rust infection type in wheat.

Response value	Description	Infection type
0	No visible symptoms	Immune (0)
0.2	Uredia minute, supported by distinct necrotic area	Resistant (R)
0.4	Uredia small to medium, in green islands surrounded by chlorotic tissue	Moderately resistant (MR)
0.8	Uredia medium in size, no necrotic but chlorotic areas may be present	Moderately susceptible (MS)
1	Uredia large, no necrosis but chlorosis may be evident	Susceptible (S)

TABLE 4. Means of heading date, maturity date and plant height as affected by wheat cultivars and N- fertilizer rates during 2016/17 and 2017/18 seasons.

Traits	Heading date (days)		Maturity (days)		Plant height (cm)	
	2016/2017	2017/2018	2016/2017	2017/2018	2016/2017	2017/2018
(A) Cultivars						
Gemmeiza 11	88.7 c	91.7 c	136.1 c	139.1 c	110.51	113.015
Shandaweel 1	90.65 b	93.65 b	138.45 b	141.45 b	109.48	111.98
Giza 168	92.4 a	95.4 a	139.9 a	142.9 a	111.30	113.805
F test	*	*	*	*	Ns	Ns
LSD (0.05)	0.811	1.254	1.33	1.439	-	-
(B) N fertilizer						
0kg N fed^{-1}	87.83 d	90.83 d	133.33 e	136.33 e	105.66 c	108.166 c
25kg N fed^{-1}	89.91 c	92.91 c	136.25 d	139.25 d	109.36 b	111.866 b
50kg N fed^{-1}	90.75 bc	93.75 bc	138.33 c	141.33 c	113.03 a	115.533 a
75kg N fed^{-1}	91.5 b	94.5 b	140.41 b	143.416 b	112.84 a	115.341 a
100kg N fed^{-1}	92.91 a	95.91 a	142.41 a	145.416 a	111.25 a	113.758 a
F test	*	*	*	*	*	*
LSD (0.05)	1.015	0.948	1.12	1.29	1.69	1.804
(C) Interactions						
(AXB)	Ns	Ns	Ns	Ns	Ns	Ns

Values followed by the same letter are not significantly different at P≤ 0.05 according to Duncan's multiple range test.

TABLE 5. Means of spikes m^{-2}, grains $spike^{-1}$, grain weight $spike^{-1}$ and 1000 kernel weight as affected by wheat cultivars and N fertilizer rates during 2016/17 and 2017/18 seasons.

Traits	Number of spikes m^{-2}		Number of grains $spike^{-1}$		Grain weight $spike^{-1}$ (g)		1000 kernel weight (g)	
	2016/17	2017/18	2016/17	2017/18	2016/17	2017/18	2016/17	2017/18
(A) Cultivars								
Gemmeiza 11	312.7	315.7	71.95	74.95	3.352 a	5.852 a	51.912 a	54.417 a
Shandaweel 1	324.3	327.35	72.35	75.35	2.609 c	5.109 c	43.885 b	46.385 b
Giza 168	324.3	326.5	70.35	73.35	3.059 b	5.559 b	50.293 a	52.793 a
F test	Ns	Ns	Ns	Ns	*	*	*	*
LSD (0.05)	-	-	-	-	0.148	0.148	2.221	2.221
(B) N fertilizer								
0kg N fed^{-1}	292.41 d	295.416 d	60.333 d	63.333 d	2.635 c	5.135 c	44.207 c	46.707 c
25kg N fed^{-1}	305.0 c	308.000 c	66.916 c	69.916 c	2.954 bc	5.454 bc	47.504 b	50.004 b
50kg N fed^{-1}	322.66 b	325.666 b	71.083 b	74.083 b	2.877 bc	5.377 bc	48.156 b	50.656 b
75kg N fed^{-1}	330.83 b	333.833 b	80.833 a	81.583 a	3.447 a	5.947 a	50.845 a	53.345 a
100kg N fed^{-1}	350 a	353.000 a	78.583 a	83.833 a	3.120 ab	5.620 ab	52.779 a	55.279 a
F test	*	*	*	*	*	*	*	*
LSD (0.05)	9.63	9.753	3.136	3.528	0.264	0.398	2.42	2.47
(C) Interactions								
(AXB)	Ns	Ns	Ns	Ns	Ns	Ns	*	*

Values followed by the same letter are not significantly different at P≤ 0.05 according to Duncan's multiple range test.

In addition, increasing the applied N level from 0 to 75kg N fed^{-1} increased significantly no. of spikes m^{-2}, no. of grains, grain weight, Kernel weight, biological, grain and straw yield. In other words, the highest values of these traits were got when 75kg N fed^{-1} was used with insignificant differences with values obtained with application of 100kg N fed^{-1} level (Tables 5, 6). Concerning no. of spikes m^{-2} trait the highest number was recorded by application of 100kg N fed^{-1}. However, the lowest values were scored under control treatment (0kg N fed^{-1}). That increment in biomass and grain yield with increasing N level may be attributed to the pivotal role of nitrogen in enhancing plant height, tiller numbers, accumulation of dry matter and grain yield components.

The effect of interactions between wheat cultivars and nitrogen levels were not significant for all previous mentioned traits, except for 1000 kernel weight where it was significant (Table 7). However, Gemmeiza 11 cultivar recorded the highest 1000 kernel weight under the application of 75kg N fed^{-1} with insignificant differences with the values recorded by same cultivar under the application of 100kg N fed^{-1} in both seasons.

TABLE 6. Means of biological, grain and straw yield as affected by wheat cultivars and N- fertilizer rates during 2016/17 and 2017/18 seasons.

Traits	Biological yield (ton fed^{-1})		Grain yield (Ardb fed^{-1})		Straw yield (ton fed^{-1})	
	2016/17	2017/18	2016/17	2017/18	2016/17	2017/18
(A) Cultivars						
Gemmeiza 11	9.645 a	12.145 a	17.315	19.815	4.438 ab	6.938 ab
Shandaweel 1	9.09 b	11.59 b	17.572	20.072	4.115 b	6.615 b
Giza 168	9.99 a	12.49 a	17.297	19.797	4.663 a	7.163 a
F test	*	*	Ns	Ns	*	*
LSD (0.05)	0.379	0.458	-	-	0.292	0.358
(B) N fertilizer						
0kg N fed^{-1}	7.716 d	10.216 d	14.041 c	16.541 c	3.481 b	5.981 b
25kg N fed^{-1}	8.475 c	10.975 c	16.591 b	19.091 b	3.67 b	6.17 b
50kg N fed^{-1}	10.141 b	12.641 b	18.025 ab	20.525 ab	4.703 a	7.203 a
75kg N fed^{-1}	10.783 a	13.283 a	19.529 a	22.029 a	5.024 a	7.524 a
100kg N fed^{-1}	10.758 a	13.258 a	18.787 a	21.287 a	5.147 a	7.647 a
F test	*	*	*	*	*	*
LSD (0.05)	0.586	0.616	2.022	2.154	0.436	0.458
(C) Interactions						
(AXB)	Ns	Ns	Ns	Ns	Ns	Ns

Values followed by the same letter are not significantly different at P≤ 0.05 according to Duncan's multiple range test.

TABLE 7. Effect of interaction between wheat cultivars and N fertilizers rates on 1000 kernel weight (g) during both seasons.

(A) Cultivars	1000 kernel weight (g)									
	(B) N-fertilizer									
	0kg N fed^{-1}		25kg N fed^{-1}		50kg N fed^{-1}		75kg N fed^{-1}		100kg N fed^{-1}	
	2016/17	2017/18	2016/17	2017/18	2016/17	2017/18	2016/17	2017/18	2016/17	2017/18
Gemmeiza 11	47.22	49.72	51.91	54.41	50.29	52.79	56.39	58.89	53.77	56.27
Shandaweel 1	40.64	43.15	39.07	41.57	44.69	47.19	42.33	44.83	52.68	55.18
Giza 168	44.76	47.26	51.53	54.03	49.47	51.97	53.82	56.32	51.88	54.38
F test	*									
LSD 0.05 (2016/17)	7.62									
LSD 0.05 (2017/18)	8.55									

From pathological point of view, wheat cultivars and N application level had a significant ($P \leq 0.05$) impact on final grain yield in both seasons (Tables 4-7). Yellow and leaf rusts infection and the interaction of rusts infection and cultivar also had a significant effect on yield ($P \leq 0.05$). It was noticed that, the output of dry biomass increased with increasing levels of N application for rust free plots. At the highest rate of N application the yield of biomass was lower in rust infected plots compared to rust free plots. At all limits of N application rate, plots with low rust registered higher yield compared to high rust infection plots. And also, the highest values of grain, straw and biological yields, days to heading, maturity, plant height, spikes number, grains number, weight of grain and weight of kernel were registered by the N application level of 75kg N fed^{-1} for most of the wheat cultivars (Tables 4-7). For Gemmeiza-11 kernel weight (g) was 47.22, 51.91, 50.29, 56.39, 53.77 for 2017 and 49.72, 54.41, 52.79, 58.89, 56.27 for 2018, respectively and for Shandaweel 1 was 40.64, 39.07, 44.69, 42.33, 52.68 for 2017 and 43.15, 41.57, 47.19, 44.83, 55.18 for 2018, respectively and for Giza 168 was 44.76, 51.53, 49.47, 53.82, 51.88 for 2017 and 47.26, 54.03, 51.97, 56.32, 54.38 for 2018, respectively at N rates 0, 25, 50, 75, 100kg N fed^{-1}. Gemmeiza 11 was also early in heading and maturity date. On the other hand, Giza 168 recorded the latest heading and maturity dates but ranked the first in plant height and straw yield fed^{-1} traits with insignificant variations with Gemmeiza 11 cultivar in both seasons.

N application rate had also effect seedling dry weight, germination percentage, seedling length and nitrogen content of wheat cultivars significantly during both seasons (Table 8). Ash & Brown (1991) and Danial & Parlevliet (1995) found that the increasing levels of N increased the severity of rusts during grain filling although N application increased grain protein content and yield in all varieties in both seasons. This suggests that stripe rust severity increased as N level increased. Pearman & Thomas (1977) concluded that this may be owing to higher levels of N lead to higher leaf area index. Yellow and leaf rusts decreased grain yield of the susceptible wheat variety in both seasons, also reduced grain protein content as in Gemmeiza 11 in 2016/17 season. Reduction in yield may be owing to loss of photosynthetic area (Robert et al., 2005). Dimmock & Gooding (2002) found that the reduced in carbohydrate available for grain filling would be supposed to increase relative protein content as is typically seen when necrotrophic foliar diseases reduce yield. While, our experiments with rust diseases displayed a lowering in yield accompanied by either no change or a lowering in protein content, suggesting that the total amount of N entering the grain was decreased (Table 8). Different mechanisms found for this effect. The first is the removal of N from the plant tissues by the pathogen, mainly as spores. Robert et al. (2002) reported that N content of leaf rust spores was smaller, and C content higher, than those of wheat leaves, indicating that rust pathogens don't remove N from the plant at a higher rate than C. The other mechanisms are decreased uptake of N and decreased remobilization from vegetative tissue into the grain after anthesis. Both uptake and remobilization are decreased by late infections with air borne diseases (Bancal et al., 2008). Bancal et al. (2008) noticed that variation in late N uptake had a bigger impact on N yield than variation in remobilization in wheat crop affected by *Septoria tritici* blotch and leaf rust. The impacts of yellow rust on N yield that noted in this study were thus most likely due to decreased uptake of N during grain filling. Yellow rust clearly has the capability to effect on the economics of N fertilization, but such an impact wasn't regular between the trials. The impacts of cultivars and environment on N utilize in the presence of rust should be explored further.

Disease assessment and the Interactions between N application and rust severity

In both wheat growing seasons, leaf and yellow rust severity increased with increasing the level of N application, i.e., 0, 25, 50, 75 and 100kg N fed^{-1}. For leaf rust the average coefficient of infection was 55, 57.5, 70, 86.25, 90% in 2017 and 42.5, 52.5, 61.25, 77.5, 90% in 2018 in Gemmezia 11, 0, 0, 0, 3.75, 10 % in 2017 and 0, 0, 0, 2.5, 7.5% in 2018 in Shandaweel 1 and 0, 0, 0, 0, 0% in 2017 and 0, 0, 0, 0, 0% in 2018 in Giza 168, while for yellow rust the average coefficient of infection was 36, 44, 50, 56, 61% in 2017 and 40, 47.5, 52.5, 60, 65% in 2018 in Gemmezia 11, 11, 19, 21, 25, 29% in 2017 and 15, 22.5, 25, 26.25, 30.8% in 2018 in Shandaweel 1 and 6.3, 14, 19, 24, 30% in 2017 and 10, 17.5, 22.5, 27.5, 35% in 2018 in Giza 168 at N rate 0, 25, 50, 75, 100kg N fed^{-1}, respectively. Results revealed that the values of area under disease progress curves and average coefficient of infection increased with increasing the levels of N-fertilizers (Tables 9, 10) and showed that all cultivars were susceptible to yellow rust disease and shown significance differences in infection at different N application ratio. But for leaf rust disease it is found that Gemmezia 11 was the highest susceptible cultivar to the infection followed by Shandaweel 1 at the higher rate of N application. On the other hand, Giza 168 was resistant to leaf rust infection. Olesen et al. (2003a) found nitrogen enhance epidemic evolution of several biotrophic fungal diseases. Bryson et al. (1997), Jensen & Munk (1997) found that the increasing in N can create more favorable microclimate for the cycling of fungal diseases in leaf as a result of increased crop density and canopy size which leads to higher humidity within the canopy. Neumann et al. (2004) reported that even though increasing N availability raising leaf area and number of tillers, there was also a significant increase in the severity of rust disease which was associated to a substrate effect rather than just microclimate changes correlated with canopy growth. Singh et al. (2002) noted yellow rust fungus uses water and nutrients from the host cells, which weakens the plants. Hatfield & Pinter (1993), Nilsson (1995) and Zhang et al. (2003) found that disease infection elicit physiological reactions within the plant leading to reduced chlorophyll content (chlorosis) and changes in internal form and water dysfunction within the plant. Nilsson (1995) and Nicolas (2004) found that at the foliar system level, a pathogen infects the leaves or another part of the plant is often associated by a reduction in stomatal conductance, consequently decreasing the plant transpiration then growth.

TABLE 8. Effect of N- fertilizer rates on seedling dry weight, germination percentage, seedling length and nitrogen content of some wheat cultivars during 2016/17 and 2017/18 seasons.

Treatments	SDW(g)		Germination percentage		Seedling length (cm)		Nitrogen content (%)	
	2016/17	2017/18	2016/17	2017/18	2016/17	2017/18	2016/17	2017/18
(A) Cultivars								
Gemmeiza 11	0.3271	0.3271	86.2	86.2	17.7	17.7	10.8	10.8
Shandaweel 1	0.2992	0.2992	82.0	82.0	18.2	18.2	12.49	12.49
Giza 168	0.2953	0.2953	82.8	82.8	16.15	16.15	11.285	11.285
F test	Ns	Ns	Ns	Ns	*	*	*	*
LSD (0.05)	-	-	-	-	1.516	1.516	0.1066	0.1066
(B) N fertilizer								
0kg N fed^{-1}	0.3221	0.3221	80.66	80.66	16.83	16.83	10.89	10.89
25kg N fed^{-1}	0.2952	0.2952	83.66	83.66	18.5	18.5	11.15	11.15
50kg N fed^{-1}	0.3492	0.3492	82	82	17.66	17.66	11.42	11.42
75kg N fed^{-1}	0.2921	0.2921	79.6	79.6	16.66	16.66	11.81	11.81
100kg N fed^{-1}	0.2774	0.2774	92.33	92.33	17.08	17.08	12.3	12.3
F test	*	*	*	*	Ns	Ns	*	*
LSD (0.05)	0.03891	0.03891	7.562	7.562	-	-	0.1377	0.1377
(C) Interactions								
(AXB)	Ns	Ns	*	*	Ns	Ns	*	*

SDW: Sseedling dry weight.

TABLE 9. Rust severity and their ACI of the tested wheat cultivars during 2016/17 and 2017/18 growing seasons at different N fertilizer rates.

Cultivars	N-rate	Yellow rust*				Leaf rust*			
		2016/2017		2017/2018		2016/2017		2017/2018	
		RS	ACI	RS	ACI	RS	ACI	RS	ACI
Gemmeiza 11	0kg N fed^{-1}	36S	36	40S	40	55S	55	42.5S	42.5
	25kg N fed^{-1}	44S	44	47.5S	47.5	57.5S	57.5	52.5S	52.5
	50kg N fed^{-1}	50S	50	52.5S	52.5	70S	70	61.25S	61.25
	75kg N fed^{-1}	56S	56	60S	60	86.25S	86.25	77.5S	77.5
	100kg N fed^{-1}	61S	61	65S	65	90S	90	90S	90
Shandaweel 1	0kg N fed^{-1}	11S	11	15S	15	0	0	0	0
	25kg N fed^{-1}	19S	19	22.5S	22.5	0	0	0	0
	50kg N fed^{-1}	21S	21	25S	25	0	0	0	0
	75kg N fed^{-1}	25S	25	26.25S	26.25	3.75S	3.75	2.5S	2.5
	100kg N fed^{-1}	29S	29	30.83S	30.83	10S	10	7.5S	7.5
Giza 168	0kg N fed^{-1}	6.3S	6.3	10S	10	0	0	0	0
	25kg N fed^{-1}	14S	14	17.5S	17.5	0	0	0	0
	50kg N fed^{-1}	19S	19	22.5S	22.5	0	0	0	0
	75kg N fed^{-1}	24S	24	27.5S	27.5	0	0	0	0
	100kg N fed^{-1}	30S	30	35S	35	0	0	0	0
LSD (0.05)		-	5.66	-	8.25	-	27.76	-	33.66

RS= Rust severity; ACI= The average coefficient of infection; S= Susceptible.
*Mean value of 4 observations.

TABLE 10. Effect of N fertilizer rates and wheat cultivars on AUDPC of yellow and leaf rust during 2016/17 and 2017/18 growing seasons.

Treatments	Yellow rust		Leaf rust	
	AUDPC			
	2016/2017	2017/2018	2016/2017	2017/2018
(A) Cultivars				
Gemmeiza 11	572.075 a	615.125 a	832.125 a	762.125 a
Shandaweel 1	205.625 b	265.125 b	10.5 b	15.75 b
Giza 168	183.75 b	224.00 b	16.625 b	10.5 b
F test	*	*	*	*
LSD (0.05)	98.8852	93.353	50.0087	50.796
(B) N fertilizer				
0kg N fed^{-1}	183.75 e	223.125 e	218.75 d	189.583 d
25kg N fed^{-1}	258.125 d	294.583 d	210 d	189.583 d
50kg N fed^{-1}	323.75 c	361.66 c	255.208 c	233.333 c
75kg N fed^{-1}	393.458 b	450.625 b	345.625 b	312.083 b
100kg N fed^{-1}	443.333 a	510.41 a	402.5 a	389.375 a
F test	*	*	*	*
LSD (0.05)	33.387	33.076	24.579	29.536
(C) Interactions				
(AXB)	Ns	Ns	*	*

Values followed by the same letter are not significantly different at P≤ 0.05 according to Duncan's multiple range test; AUDPC: Area under disease progress curve.

Conclusion

From these results it is concluded that there are positive correlations between N application rate and both of yield production and rust severity of wheat cultivars. Therefore it is obvious that N is a key factor affecting growth features and evolution of pathosystems in wheat, subsequently affecting on crop productivity.

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استجابة بعض أصناف القمح لمعدلات التسميد النيتروجيني المختلفة وارتباطها بأمراض الأصداء

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إن استخدام التسميد النيتروجيني من شأنه أن يؤدي إلي تحسين أداء أصناف القمح وجودة الحبوب ومعروف بتاثيره على مستويات الإصابه بأمراض الإصداء. لذا تهدف هذه الدراسة إلى تقييم أداء بعض أصناف القمح للإستجابة لمعدلات التسميد النيتروجيني المختلفة للوصول لأفضل معدل لكل صنف وتأثيرة على تطور الإصابه بأمراض الأصداء (الصدأ الأصفر وصدأ الأوراق) ونفذت هذه الدراسه خلال الموسمين الشتويين لعامي 2016-2017 و 2017-2018. اعتمدت الدراسة على ثلاثة أصناف من قمح الخبز وهي جميزة 11 و شندويل 1 وجيزة 168 وكانت معدلات التسميد النيتروجيني هي صفر،25،50،75 و100 كيلو جرام نيتروجين للفدان. أشارت النتائج إلى أنه عند معدل تسميد 75 كيلو جرام نيتروجين للفدان كان الصنف جميزة 11 الأعلى في وزن الالف حبه يليه الصنف جيزة 168 ثم الصنف شندويل1. أشارت النتائج أن تأثير التفاعل بين معدلات التسميد النيتروجيني والأصناف كان معنويا في كلا الموسمين. كذلك اشارت النتائج بأن الصنف جيزة 168 والصنف شندويل 1 كانوا الأكثر مقاومه لأمراض الأصداء يليهم الصنف جميزة 11 .أوضحت الدراسه بانه بزيادة معدلات التسميد الأزوتي ادت لزيادة الإصابه بأمراض الأصداء وتطورها مما ادى لتاثيرها على ناتج المحصول. لذلك أوضحت الدراسه بأن هناك علاقه طرديه بين معدلات التسميد الأزوتي وكلا من ناتج المحصول والإصابه بأمراض الأصداء.