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# TOLERANCE TO SOME SUSCEPTIBLE EGYPTIAN WHEAT VARIETIES TO LEAF RUST

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**ABSTRACT:** *Thirteen wheat genotypes, released in Egypt, were tested against leaf rust (Puccinia triticina) under field conditions at Sakha Agric. Res. Station during two successive growing seasons i.e. 2011/12 – 2012/13 in nurseries surrounded with spreader area of highly susceptible genotypes. Inoculation with a mixture of leaf rust as a source of inoculia was carried out. Rust data were recorded as severity%, and area under diseases progress curve (AUDPC). Results obtained showed that cvs. Sids 12, Sids 13 and Misr 1 were resistant. On the other hand cvs. Gemmeiza 7, Gemmeiza 9, Gemmeiza 10, Gemmeiza 11, Sakha 61,Sakha 93, Sakha 94, Sids 1, Misr 2 and Giza 168 were susceptible to leaf rust. cvs. Sakha 93, Gemmeiza 7 and Sids1 showed the highest disease severity and AUDPC which gave the highest yield losses. On the other hand, cvs. Msr 2, Giza 168, Gemmeiza 11 and Sakha 94 gave low yield losses and therefore they are considered tolerant to the concerned disease. These results would serve as a fruitful tool in the wheat breeding program for disease resistance.*

***Key words:*** *Wheat, Leaf rust, Adult plant resistance.*

## INTRODUCTION

Leaf rust caused by *Puccinia triticina* is one of the most important diseases of wheat and widely distributed wherever the crop is grown. It is a regularly occurring disease on wheat. The disease is one of the major diseases which attacks the wheat plants in Egypt annually occurs causing considerable losses in grain yield especially in the northern areas of Delta where high level of relative humidity is suitable for disease development. Generally, resistance may be effective at seedling and/or adult plant stage, however, plants may show different reactions from seedling to adult plant stage or all over the plant life from seedling to adult.

Losses in grain yield of the susceptible genotypes may be different from genotype to others. When the losses in grain yield of the susceptible genotype are not significant, such genotypes can be described as tolerant to disease infection (Parlevliet 1973 and Caldwell *et. al.* 1958). Caldwell *et. al.* (1958) was the first to define the tolerance as the ability of the susceptible genotypes to decrease the yield losses caused by infection.

Therefore, the present study was designed to study the tolerance of the susceptible genotypes to leaf rust in 10 wheat genotypes by scoring the rust severity and estimating the AUDPC.

## MATERIALS AND METHODS

To determine the level of adult plant resistance (field resistance), thirteen Egyptian wheat cultivars were grown under field conditions in a randomized complete block design with four replicates in two successive growing seasons 2010/11-2011/12 at Sakha Agricultural Research Station. The plot size was 6 × 7 = 42 $m^{2,}$ each plot included 20 rows with 6 m long and 30 cm apart. All recommended cultural practices were carried out according to the technical recommendation of the crop. The experiment plots were surrounded by spreader area grown to highly susceptible genotypes to leaf rust (Morocco) act as spreader for the disease. Artificial inoculation was carried out using a mixture of leaf rust races and talcum powder at a ratio of 1:20 (v/v) (Tarvet and Cassel, 1951). Leaf rust severity (%) was determined in all of the tested genotypes according to modified Cobb scale 0- 100% (Peterson *et*

*al.*, 1948). Disease severity was recorded at 10 days intervals.

AUDPC was also assessed for each genotype according to the equation adopted by Pandy *et. al.*, (1989)

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

Where: D = days between each two consecutive records (Time intervals)

$Y_{1+} Y_k$ = sum of first and last disease record

$Y_2 + Y_3 \ldots\ldots\ldots Y_{k-1}$ = sum of all in between disease records

Statistical analysis, and least significant differences (L.S.D at 5%) were used to yield components according to ( Snedecor, 1957).

To study the response of the adult plant of the wheat genotypes to leaf rust infection, protected plots of the same genotypes were treated by the effective fungicide Sumi- eight 5% Ec((E)- (RS)-1-(2,4- dichloropheny)- 4, 4 – dimethyl- ( 1H- 1, 2, 4 – triazol- 1-yl) pent - 1- enzol) 35 cm / 100 litter water compared to the protected genotypes under field conditions. Yield loss was estimated using the equation adopted by Colpauzos *et. al.* (1976) as follows:

Losses %= 1- Yd / Yh × 100

Where: Yd = yield of planes

Yh= yield of healthy plant

## RESULTS AND DISCUSSION

The present study clearly showed that the wheat tested genotypes susceptible showed high leaf rust disease severity and exhibited high values of AUDPC and yield losses. While some wheat genotypes which showed high disease severity and displayed high values of AUDPC gave low yield losses and therefore, they can be described as tolerant genotype.

The reaction of the commercial wheat genotypes to leaf rust at adult plant stage under field conditions is shown in Table 1. The fungicide-protected plots remained almost free from stem rust during the two growing seasons of this study (2011/12 and 2012/13).

In 2011/12 and 2012/13 growing season, all of the tested wheat genotypes showed different disease severity ranged from 10 to 80 % Table (1). The cvs. Misr 1, Sids 12 and Sids 13 showed the least disease severity (10 MR), followed by Misr 2 and Giza 168 (10 MS). While, the rest of the tested genotypes exhibited rust severity ranged from 10 % to 80 %.

According to the obtained data, the wheat cvs. Misr1, Misr 2, Sids 12, Sids13 and Giza 168 showed the high level of adult plant resistance, since they showed the lowest rust severity, On the other hand, wheat cvs. Gemmeiza 7, Sakha-93, Sakha-61 and Sids-1 gave the lowest level of rust severity in the field (El-Orabey, 2008 and Nazim *et al.,* 2001).

### Area under disease progress curve (AUDPC):

Data in Table (1) indicated that AUDPC runs in a parallel line with disease severity. In 2011/12 growing season, the results obtained showed that the highest values of AUDPC were observed on cvs. Sids 1, Gemmeiza 7, Sakha 61, Sakha 93, Gemmeiza 9 and Gemmeiza (1350, 1350, 1100, 650 and 610 respectively). Whereas, cvs. Sakha 94, Gemmeiza 10, Misr 1, Misr 2, Giza 168, Sids 12 and Sids 13 exhibited low values of AUDPC i.e. 220, 176, 68, 56, 56, 28 and 28, respectively.

In 2012/13 growing season, data in Table (1) indicates that the cvs. Sids 1, Gemmeiza 7, Sakha 61, Sakha 93, Gemmeiza 9 and Gemmeiza 11 showed the highest values of AUDPC i.e. 1125, 1000, 925, 925,610 and 410, respectively. While cvs. Gemmeiza 10, Sakha 94, Giza 168,Sids 12, Misr 2, Sids 13 and Misr 1 showed lower values of AUDPC i.e. 136, 120, 96, 96, 44, 44, and 28, respectively. El- Orabey (2008) found that AUDPC is good indicator of adult plant resistance under field conditions. Wheat genotypes were classified into two main groups. The first group included wheat genotypes that display low levels of rust severity under field conditions during the two seasons. These genotypes showed the lowest AUDPC values less than 250

including cvs. Misr 1, Misr 2, Sids 12, Sids-13 and Giza-168. The second group of wheat genotypes included the highly susceptible or ones of high levels of rust severity. These wheat genotypes displayed high AUDPC values (More than 250) which included cvs. Sids 1, Gemmeiza 7, Sakha 93, Sakha 61, Gemmeiza 9 and Gemmeiza 11. (Th.Kramer *et. al.*, 1980, Broers, 1989, Pretorius *et. al.*, 1996, Kaur *et. al.*, 2000, Nazim *et. al.*, 2001, and Khanna *et. al.*, 2005).

**Table (1): Final rust severity and area under disease progress curve for 13 wheat genotypes during the growing seasons 2011/12 and 1012/13.**

| Variety | 2011/2012 | | 2012/13 | |
|---|---|---|---|---|
| | Final Rust severity % | AUDPC | Final Rust severity % | AUDPC |
| **The susceptible genotypes** | | | | |
| Gemmeiza-7 | 80S | 1350 | 60S | 925 |
| Gemmeiza-9 | 50S | 650 | 40S | 610 |
| Gemmeiza-10 | 20S | 176 | 20S | 136 |
| Gemmeiza-11 | 40S | 610 | 30S | 410 |
| Sakha 61 | 70S | 1100 | 60S | 925 |
| Sakha-93 | 70S | 1000 | 70S | 1000 |
| Sakha -94 | 20S | 220 | 10S | 120 |
| Misr- 2 | 10MS | 56 | 10MS | 44 |
| Giza -168 | 10MS | 56 | 10MS | 96 |
| Sids-1 | 80S | 1350 | 80S | 1125 |
| **The resistant genotypes** | | | | |
| Sids-12 | 10MR | 28 | 10MR | 96 |
| Sids-13 | 10MR | 28 | 10MR | 44 |
| Misr -1 | 10MR | 68 | 10MR | 28 |

## Grain yield and yield losses:

The 1000 kernel weight and grain yield per plot were different between protected and infected wheat genotypes due to the differences in the level of disease severity of leaf rust as shown in Tables 2 and 3. In 2011/12, the loss % of the 1000 kernel weight ranged from 2.36% to 20.03 %. The cvs. Sakha 93, Sakha61, Gemmeiza 7 and Gemmeiza 9 gave the highest values of loss % of 1000 kernel weight (20.03, 12.12, 11.72 and 10.64 respectively) compared to the other genotypes. In 2012/13, the loss % in the 1000 kernel weight ranged from 1.36 % to 19.62 %.

**Table (2): Effect of leaf rust severity on yield components of 10 susceptible wheat genotypes -2011/ 12.**

| Variety | 1000 kernel weight (g) | | | Yield/Plot (Kg) | | |
|---|---|---|---|---|---|---|
| | Infected | Protected | Losses % | Infected | Protected | Losses % |
| Gemmeiza-7 | 41.63 | 47.16 | 11.72 | 18.61 | 21.50 | 13.44 |
| Gemmeiza-9 | 41..37 | 46.30 | 10.64 | 21.12 | 23.00 | 8.17 |
| Gemmeiza-10 | 39..37 | 41.30 | 4.6 | 25.42 | 26.00 | 2.23 |
| Gemmeiza-11 | 42..35b | 45.30 | 6.50 | 32.06 | 33.50 | 4.29 |
| Sakha-61 | 37.48 | 42.64 | 12.12 | 15.7 | 18.5 | 15.13 |
| Sakha -93 | 35.13 | 43.93 | 20.03 | 19.12 | 23.00 | 16.86 |
| Sakha--94 | 43.26 | 44.35 | 2.45 | 25.67 | 26.00 | 1.26 |
| Misr- 2 | 43.40 | 44.45 | 2.36 | 31.75 | 32.65 | 2.75 |
| Giza-168 | 40.74 | 41.84 | 2.60 | 25.2 | 26.10 | 3.44 |
| Sids-1 | 42.74 | 45.25 | 5.54 | 21.5 | 23.00 | 6.52 |
| L.S.D | | 0.681 | | | 2.179 | |

**Table (3): Effect of leaf rust severity on yield components of 10 susceptible wheat genotypes -2012/ 13.**

| Variety | 1000 kernel weight (g) | | | Yield/Plot (Kg) | | |
|---|---|---|---|---|---|---|
| | Infected | Protected | Losses % | Infected | Protected | Losses % |
| Gemmeiza-7 | 40.63 | 46.70 | 12.99 | 17.61 | 20.44 | 13.84 |
| Gemmeiza-9 | 41.13 | 46.15 | 10.87 | 20.2l | 22.70 | 10.92 |
| Gemmeiza-10 | 39.36 | 41.32 | 4.74 | 24.42 | 25.10 | 2.70 |
| Gemmeiza-11 | 42.38 | 45.60 | 7.06 | 30.06 | 32.51 | 4.60 |
| Sakha 61 | 36.42 | 43.81 | 16.86 | 14.60 | 17.50 | 16.57 |
| Sakha-93 | 34.41 | 42.81 | 19.62 | 18.62 | 22.11 | 15.78 |
| Sakha -94 | 42.56 | 43.15 | 1.36 | 23.67 | 24.15 | 1.98 |
| Misr- 2 | 43.40 | 44.45 | 2.36 | 31.75 | 32.65 | 2.75 |
| Giza -168 | 40.56 | 41.74 | 2.82 | 24.30 | 25.10 | 3.18 |
| Sids-1 | 42.65 | 45.35 | 5.95 | 21.45 | 22.90 | 6.33 |
| L.S.D | | 0.0512 | | | 2.20 | |

The cvs. Sakha 93, Sakha 61, Gemmeiza 7, Gemmeiza 9 and Gemmeiza 11 gave the highest values of loss % of the 1000 kernel weight (19.62 %, 116.86 %, 12.99 %, 10.87 and 7.06 %, respectively) followed by cvs. Sids 1, Gemmeiza 10, Giza 168 and Sakha 94 were susceptible reaction gave the lowest values loss % i.e. (5.95, 4.74, 2.82, and 1.36 respectively).

The loss % of yield per plot in 2011/12 ranged from 2.23 % to 16.86 %. The cvs. Sakha 93, Sakha 61, Gemmeiza 7 and Gemmeiza 9 showed the highest values of loss % of yield per plot (16.86%, 15.13%, 13.44 % and 8.17 %) compared to the other genotypes. In 2012/13, the loss % of yield per plot ranged from 1.98 % to 16.57 %. The cvs. Sakha 61, Sakha 93, Gemmeiza 7 and Sids 1 highest of yield per plot (16.86%, 15.13%, 13.44 % and 8.17 % respectively) compared to the other genotypes.

In 2012/13, the loss % of yield per plot ranged from 1.98 % to 16.57 %. The Cvs. Sakha 61, Sakha 93, Gemmeiza 7 and Gemmeiza 9 gave the highest values of loss % of yield per plot (16.57 %, 15.78 %, 13.84 % and 10.92 %, respectively). While, the cvs. Gemmeiza 11, Giza 168, Gemmeiza 10, Misr1and Sakha 94 showed the lowest values of loss % of yield per plot. This trend is in a harmony with losses reported in previous studies obtained by El-Orabey (2008) Ochoa and Parlevliet (2007) reported that yield loss was correlated strongly with area under disease progress curve, which means that high levels of partial resistance are needed to prevent significant yield loss.

Tolerance levels of the used genotypes to leaf rust infection, data in table (1,2 and 3) showed the presence of significant difference in disease severities under field conditions. Results indicated that cvs Misr2, Giza 168 Gemmeiza 10, Gemmeiza 11 and Sakha 94 were tolerant since they showed lower values of yield loss during the two seasons ranged between ( 0.20% and 6.5%) in 1000 grain weight and (0.32% and 6.52) in grain yield/ plot, followed by cvs. Gemmeiza 9 which exhibited moderate loss % in both of the two seasons. Whereas cvs. Gemmeiza-7, Sakha-93 and Sakha-61 showed the high values of loss %. Similar results were obtained by Syed *et al*. (2007) who reported that cvs. Inquilab-91 was the tolerant one which showed 5.77% loss in 1000 grain weight followed by cvs. Wafaq in Pakistan. Ahmed *et al*. (2010) and El-Shamy *et. al*. (2011) reported that, the susceptible genotypes showed higher yield losses as compared to resistant genotypes.

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# التحمل في بعض الأصناف المصرية ضد مرض صدأ الورقة

**ممدوح عبد المنعم عشماوي**

مركز البحوث الزراعية – معهد بحوث امراض النبات

## الملخص العربى

تم اختبار 13 صنف من اصناف القمح المصرية ضد مرض الصدأ البرتقالي تحت ظروف الحقل فى محطة البحوث الزراعية في سخا خلال الموسمين 2012/2011– 2013/2012 وكانت النتائج المتحصل عليها كالتالي . سجلت الدراسة علي قياس الشدة المرضية والمساحة الواقعة تحت المنحني المرضي وعلاقتها بالفقد في المحصول ووزن 1000 حبة. سجلت الأصناف سدس 12 و سدس 13 و مصر 1 كانت مقاومة ومن ناحية أخرى جميزة 7 و جميزة 9 و جميزة 10 و جميزة 11 وسخا 61 و سخا 93 و سخا 94 و سدس 1 كانت قابلة للإصابة بالصدأ البرتقالي. كانت الأصناف سخا 93 وجميزة 7 وسدس 12 أظهرت نسبة عالية في شدة الإصابة والمساحة الواقعة تحت المنحني المرضي واعلي نسبة فقد سواء في وزن 1000 حبة ووزن الحوض. وجد أيضا أن الأصناف جيزة 168 ومصر 2 وجميزة 11 وسخا 94 متحملة للمرض. تعتبر هذه النتائج أداه هامة في برامج التربية لمقاومة مرض الصدأ البرتقالي.