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PERFORMANCE OF FOURTEEN EGYPTIAN WHEAT CULTIVARS TO STRIPE RUST AT DIFFERENT GROWTH STAGES

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ABSTRACT

Fourteen cultivars were used to assess the cultivars reaction and latent periods to stripe rust at various growth stages. The main objectives of this study were to evaluate the expression of adult resistances at various growth stages of fourteen wheat cultivars and to assess the effect of such resistances on stripe rust development in the filed. Fourteen wheat cultivars were evaluated for resistance in the greenhouse at four growth stages from seedling to booting using stripe rust race 198E156. Resistance was measured by infection types and latent period. The cultivars were also evaluated in the field using the same race to evaluate disease severity and disease progress.

Cultivars Sakha 69, Giza 160, Giza 163, Sids 7, Sids 8 and Sids 9 was the most susceptible cultivars (infection types 8 to 9 latent period 10-15 days), followed by Gemmeiza 7 (infection type 8-4 with latent period 12 to 22.3 days). However, as plants grew, resistance increased and was lower infection types and longer latent period. The changes in infection type displayed by Sakha 61, Sakha 93, Sakha 94, Giza 168, Sids 1, Gemmeiza 9 and Gemmeiza 10 were the greatest, intermediate reactions (infection types were 3-5 and latent period 21-23 days at tillering stages) were seen as early as the completion of stem elongation and changed to immunity infection type (0). Results obtained from field experiment revealed that cultivars Sakha 61, Sakha 69, Giza 168, Sids 1, Gemmeiza 9 and Gemmeiza 10 gave resistant reaction (0). On the other hand cultivars Sakha 69, Giza 160, Giza 163, Sids 7, Sids 8 and Sids 9 showed high susceptibility toward the stripe rust disease at seedling stage.

INTRODUCTION

Stripe rust caused by *Puccinia striiformis* is an important disease of wheat in many regions of the world. In Egypt, the most important stripe rust epidemic occurred in 1995 particularly in the North and South Delta areas. The disease is controlled mainly by the use of resistant cultivars, of which seedling resistance and high temperature and adult plant resistances are most important

Some workers, El Shamy *et al* 2006 and Abdel Kader 2006 have reported that resistance of same wheat cultivars in the adult stages differed from resistance in the seedling stage. Genes conferring seedling and adult resistance are known to occur in wheat (*Triticum aestivum*). Seedling resistance is usually race specific and can be recognized by its characteristic low infection type at all plant stages.

Adult plant resistance can be either race specific or race non specific and is usually better recognized after the seedling stage (Johnson, 1988). The objectives of this study were to determine the expression of genes for

resistance to stripe rust of Fourteen local wheat cultivars at various growth stages and to assess the effect of such resistance on stripe rust development in the field.

MATERIALS AND METHODS

The main objectives of this experiment were to evaluate the expression of adult plant resistance of fourteen local cultivars at various growth stages in the greenhouse and to assess the effect of such resistance on stripe rust development in the field. Fourteen cultivars were used to assess the cultivars reaction and latent periods to stripe rust at various growth stages. Experimental design was a randomized complete block with three replicates. Each replicate block consisted of all the fourteen cultivars to be studied at four growth stages, i.e. seedling, tillering, stem elongation and early heading. Fifteen seeds per cultivar were sown in 10 cm diameter pots at seedling stage and 25 cm diameter pot at adult stage. Plants were inoculated by virulent race 198E156. After inoculation plants were placed in dark dew chamber at 10^{o}C; and then transferred to a greenhouse at temperature 8-15^{o}C. Latent period and infection type were recorded for each of the inoculated plant. Latent period was defined as the number of days from inoculation to the appearance of the first uredinium. Infection types were assessed 20 days after inoculation by means of a 0 to 9.

Reaction of the fourteen cultivars at the field to stripe rust was evaluated at two locations during the 2006/2007 season. Environmental conditions at these sites were suitable to the development of stripe rust. A randomized complete block design with three replicates was used. Seeds of each cultivar were sown in a 2m paired rows lot (20 cm between rows) with spacing of 50 cm between plots and 1-m pathway. Each plot consisted of approximately 80-100 plants. Plants were inoculated by race 198E/56 uradospores of *Puccinia striiformis* with talcum powder at the rate of 1: 20 (w: w) was used for artificial inoculation according to the method described by Tarvet and Cassel (1951).

Using the modified Cobb scale by Peterson *et al.* (1948) disease severity was recorded. The obtained data served in determination of area under disease progress curve (AUDPC) (Pandy *et al.,* 1989).

$$AUDPC = D\left[\frac{1}{2}(y_1 + y_k) + y_3 + \ldots y_{k-1}\right]$$

Where:

D =Time interval ($y_1 + y_k$) = sum of first and last scores of disease scores and ($y_2 + y_3 + \ldots y_{k-1}$) = sum of all in between disease scores.

RESULTS AND DISCUSSION

Data presented in Table (1) showed the evaluation of fourteen wheat cultivars at seedling stage under artificial inoculation conditions to race 198 E/56. These data indicated that stripe rust reaction at seedling stage in all tested varieties was susceptible and reaction ranged from (7 to 9) S. Infection

types became lower as plants grew into post-seedling growth stages, and reductions of different degrees were observed (Table 1).

Table 1: Infection type of main wheat cultivars inoculated with *Puccinia striiformis* 198E156 at four growth stages.

Cultivar	Infection type			
	Seedling	Tillering	Stem elongation	Booting
Sakha 61	7	4	0	0
Sakha 69	9	9	9	9
Sakha 93	7	4	0	0
Sakha 94	7	4	0	0
Giza 160	9	9	9	9
Giza 163	9	9	9	9
Giza 168	7	3	0	0
Sids 1	8	5	0	0
Sids 7	9	9	9	9
Sids 8	9	9	9	9
Sids 9	9	9	9	9
Gemmeiza 7	8	7	4	4
Gemmeiza 9	7	5	0	0
Gemmeiza 10	7	5	0	0

Cultivars Sakha 61, 93, 94, Giza 168, Sids 1 and Gemmeiza 9 and Gemmeiza 10 showed intermediate reactions (mostly infection types 3-5) at tillering stages, which changed to resistant reactions after tillering, were reached immunity at stem elongation and booting stages. However cultivars Sakha 69, Giza 160, Giza 163, Sids 7, Sids 8 and Sids 9 exhibited highest infection types (9) at different growth stages (Table 1).

Obtained results suggest that adult resistance to stripe rust may begin at mid tillering as plants continue to develop, the change in infection types can be slight or large, depending on gene effect and environmental factors. In cultivars that are highly resistant in the field such as Sakha 61, Sakha 94 and Giza 168 expression may start even earlier at beginning of tillering. This agrees with findings of Qayoum and Line 1985. On winter wheat cultivars that carry genes conferring high temperature, adult plant resistance to stripe rust, changes in intermediate levels of resistance were subsequently observed in most plants after tillering.

Latent period

Data presented in Table (2) indicated that mean latent period of all tested cultivars at seedling stage were the shortest, ranged from 10 to 13.5 days. However cultivars Sakha 61, 93, 94, Giza 168, Sids1and Gemmeiza 9 and Gemmeiza 10 showed increase in latent period at tillering stage comparing to other tested cultivars. The correlation between the ranks of the cultivars for latent period and infection types suggests that cultivars with shorter latent periods generally had higher infection types in wheat stripe rust. Pathosystem, genotypes with low infection types are usually associated with less sporulation and extensive chloroetic or necrotic blotch. Qayoum and Line 1985 found that correlation between latent period, low infection frequency, and low disease severity in the field.

Table 2: Mean latent period of 14 wheat cultivars inoculated with *Puccinia striiformis* 198E156 at four growth stages.

Cultivar	Post-seedling (LPs)			
	Seedling	Tillering	Stem elongation	Booting
Sakha 61	12.6	22.3	-	-
Sakha 69	10.0	14.3	14.6	15.3
Sakha 93	12.0	21.3	-	-
Sakha 94	12.3	22.0	-	-
Giza 160	10.0	15.0	15.0	15.0
Giza 163	10.6	14.0	14.0	14.0
Giza 168	13.3	22.0	-	-
Sids 1	12.0	21.3	-	-
Sids 7	10.0	14.3	14.6	150
Sids 8	10.0	14.6	14.6	14.0
Sids 9	10.0	15.0	15.3	15.0
Gemme4iza 7	12.0	15.3	22.3	22.3
Gemmeiza 9	12.0	21.3	-	-
Gemmeiza 10	12.0	22.3	-	-

Field observation

Stripe rust began developing early in the field and became severe. Data in Table (3) present the evaluation of 14 wheat cultivates at adult stage under field conditions, these data indicated that stripe rust severity at adult stage ranged from 0 to 100 s. However, varieties Sakha 69, Giza 160, Giza 163, Sids 7, 8 and Sids 9 exhibited the highest rust severity which gave a reaction ranged from 80s to 100s. Gemmeiza 7 exhibited 50s with the exception of Sakha 61, Sakha 93, Sakha 94, Giza 168, Sids 1, Gemmeiza 9 and Gemmeiza 10 which showed resistant reaction.

Area under disease progress curves (AUDPC) is a good indication to the degree of susceptibility of wheat varieties against stripe rust infection. Data in Table (3) explain this perspective; since the highest area was recorded with varieties Giza 160 followed by Giza 163, Sakha 69, Sids 8, 9 and Sids 7. However, Gemmeiza 7 was the least in this regard susceptible. It must be taken into consideration that Sakha 61, Sakha 93, Sakha 94, Giza 168, Sids 1, Gemmeiza 9 and Gemmeiza 10 proved to be resistant and no progressive curves were detected for them.

Brorers and Lopez-Atilano (1993) suggested that the resistance component that best reflects stripe rust development under field conditions is infection frequency. Singh and Rajaram (1994) indicated that Pavon 76 carry durable yellow rust resistance, given that its moderate adult resistance that remained effective wherever it is grown. Resistance present in the studied cultivars may also carry durable yellow rust resistance.

The adult plant resistances of Sakha 61, 94, Giza 168 and Gemmeiza 9-10 may related to genes of hypersensitive nature that become effective in the early post seedling growth stages. These data are similar to results obtained by Singh and Rajaram (1994), Milus and Line (1986), Abdel Kader(2006), Singh (1992), and Broers and Lopez-Atilano (1993).

Table 3: Evaluation of 14 wheat cultivars against stripe rust infection at adult stage in two locations during 2006/2007.

Cultivar	Disease severity at adult stages		AUDPC
	Sakha	Doumit	
Sakha 61	0	0	0
Sakha 69	90s	80s	1125
Sakha 93	0	0	0
Sakha 94	0	0	0
Giza 160	100s	100s	1450
Giza 163	90s	90s	1225
Giza 168	0	0	0
Sids 1	0	0	0
Sids 7	90s	80s	1150
Sids 8	90s	90s	1225
Sids 9	90s	90s	1225
Gemmeiza 7	50s	40s	320
Gemmeiza 9	0	0	0
Gemmeiza 10	0	0	0

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اداء اربعة عشر صنف من القمح المصرى للصدأ الأصفر فى أطوار مختلفة من عمر النبات

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**** البرنامج القومى لبحوث القمح ، معهد بحوث المحاصيل الحقلية مركز البحوث الزراعية - الجيزة**

يهدف هذا العمل الى التعرف على اداء اربعة عشر صنف من القمح المصرى الصدأ الأصفر فى مراحل مختلفة من عمر النبات وتقدير كثافة المقاومة للصدأ الأصفر فى الحقل.

ظهر سبعة أصناف من القمح مقاومة للصدأ الأصفر وستة أصناف قابلة للإصابة فى أربعة مراحل من عمر النبات باستخدام السلالة 198E156 وأوضحت الدراسة أن كل الأصناف المختبرة قابلة للإصابة فى طور البادرة ومع ذلك أظهر الصنف سخا ٦١ ، سخا ٩٣ ، سخا ٩٤ ، وجيزة ١٦٨ ، وسدس ١ ، وجميزة ٩ ، ١٠ مقاومة للصدأ الأصفر بداية من مرحلة التفريع حيث تراوحت طرز العدوى الظاهرة ما بين (٣-٤) كما زدات طول فترة التكشف وبداية من مرحلة الاستطالة أظهرت هذه الأصناف المقاومة التامة.

فى نفس الوقت أظهرت باقى الأصناف المختبرة قابليتها الإصابة الشديدة فى أربعة مراحل المختلفة من عمر النبات.

هذه الدراسة أشارت إلى ان المقاومة فى النبات البالغ تبدأ فى منتصف مرحلة التفريع وتكتمل فى بداية مرحلة الاستطالة وهى بداية كفاءة الجين.