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تعريف السلالات الفسيولوجية لفطر الصدأ الأصفر في مصر من موسم ١٩٩٩/٢٠٠٠ إلي موسم ٢٠١٠/٢٠١١.

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الملخص العربي

السلالات الفسيولوجية ومدى عدوانية هذه السلالات خلال ١٢ موسم من موسم ١٩٩٩/٢٠٠٠ حتى موسم ٢٠١٠/٢٠١١ . يتم تعريف السلالات الفسيولوجية علي الأصناف المفرقة للعزلات المجمعة من الحقول المختلفة. النتائج المتحصل عليها تم تعريف ١١٤ سلالة خلال ١٢ موسم. أظهرت النتائج ٥٨ سلالة عرفت في موسم واحد فقط ثم اختفت هذه السلالات. وسلالات ظهرت في موسمين فقط وهي (2E128, 16E130, 70E120, 70E134, 70E182, 228E148, 230E191, 236E250, 230E0 and 494E158). والسلالة 0E0 ظهرت في جميع المواسم . شدة العدوانية كانت عالية علي الجينات *Yr6, Yr7, Yr8, Yr(6)* and *Yr(7)* وكانت قليلة جدا علي الجينات *Yr1, Yr4, Yr5* and *Yr10* . يمكن استخدام هذه النتائج في برنامج التربية لإنتاج الأصناف المقاومة.

PHYSIOLOGIC RACES OF WHEAT YELLOW RUST (*PUCCINIA STRIIFORMIS* F. SP. *TRITICI* IN EGYPT DURING 1999 – 2011

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ABSTRACT: *The prevailing physiologic races of Puccinia striiformis f. sp. tritici and their virulence were investigated in Egypt during 1999 – 2011. The wheat yellow rust differential genotypes were used for race identification and planted either in the field at different locations or under controlled conditions for evaluation. Results showed that 114 races were found; 58 races occurred during one season only whereas 10 races occurred during two seasons (2E128, 16E130, 70E120, 70E134, 70E182, 228E148, 230E191, 236E250, 230E0 and 494E158). On the other hand, race 0E0 was the most frequent one . Analysis of virulence showed variation in virulence among the races. Virulence frequencies were very high against Yr6, Yr7, Yr8, Yr(6) and Yr(7), while the lowest frequencies were found against Yr1, Yr4, Yr5 and Yr10. These results would serve a fruitful tool in the wheat breeding program for disease resistance.*

Key words: *Wheat, Stripe rust, Physiological races, Virulence, Frequencies.*

INTRODUCTION

Stripe rust (*Puccinia striiformis*) usually occurs at the late growth stages of wheat starting from the flowering stage. No disease infection was recorded on seedling plants under field conditions. Therefore, breeding for adult plant resistance is the most important method to control this disease under the Egyptian conditions (Abu el-Naga, 2001).

Stripe rust can be considered as a sporadic disease starting 1990's Ashmawy (2005). It appeared in epidemic case in 1967, 1983, 1996, and 1997 (Abd El-Hak, *et al.*, 1972, El-Daoudi, *et al*., 1996 and Abu el-Naga, 1999- 2001) and disappeared in the other seasons. Moreover, all wheat genotypes produced in Egypt are susceptible except for the cv. Sakha 61 which showed moderate susceptibility and proved to have a high level of partial resistance. Therefore, to protect the local genotypes from infection, by this disease, genes for resistance should be incorporated into the high yielding genotypes. Disease resistance is controlled by major or minor genes or both together, however complementary effect between major genes may enhance the response of a variety and give higher levels of resistance (Simons *et. al*., 1978).

Many of the major genes are effective through out the whole life of the plant, whereas few of them are only effective at adult stage. Resistance during later period of plant growth is called adult plant resistance as defined by Zadoks (1961) when resistance is effective in the advanced growth stages of the plant.

Expression of resistance depends on the host-parasite interaction, environmental conditions, plant growth stage and the interaction between resistance genes in the wheat genome (Kolmer, 1996).

The present investigation was directed to study the frequency of virulence against stripe rust single genes for resistance, to serve in the national breeding program for resistance in wheat to rusts..

MATERIALS AND METHODS

Field surveys and sample collection:

Regular field surveys were conducted annually across the wheat growing area in Egypt. In the Northern governorates of Egypt, Kafr elsheishk, Dakahliya and Gharbiya, in addition to certain susceptible entries involved within the wheat breeding program. The infected wheat leaves were collected from trap nurseries and commercial wheat field. Data of collection samples i.e. location; cultivar, severity, collector and any other relevant information were recorded.

Isolation and purification:

The collected samples were isolated and purified using the single pustule technique and the developed colonies were picked and multiplied on one or two of the susceptible genotypes *Triticum spelta saharense*, Morocoo and Giza 160. Ten days old seedlings of the above mentioned entries were atomized with distilled sterile water, gently rubbed between fingers in the presence of water plus few droplets of an adhesive material such as Tween 20, to remove the waxy layer on leaf and to preserve more uredospores on the leaf blade according to Stubbes 1988 with few modification (Abu el-Naga, 1999- 2001) in which uredospores were suspended in mineral oil (soltrol). The samples were purified by multiplication on susceptible wheat cultivars. Petri plates, 10 cm. in diameter, containing filter paper moistened with distilled sterile water, over which a little part of the sample was located in sterile conditions to push the pathogen for sporulation, the plates were kept in fridge to be used in inoculation thereafter.

The inoculated seedlings were kept in humid apparatus for 24-48h in darkness at 10 °C. then, transferred to the permanent cabinets day temperature was adjusted at 15 °C, light intensity was adjusted at 7500 lux and relative humidity was more than 95%. However night "temperature was adjusted at 10 °C, in darkness and relative humidity reached > 95%. The day/night rhythm was 8/16h. (**Stubbs, 1988)**.

Identification of physiologic races:

The wheat differentials listed in Table (1) were planted in a climate room under the same temperature and light conditions described above. Infection type (IT) data of the plant-pathogen interactions were recorded at 15-20 days by IT based on the 0 to 9 scale adopted by Mc Neal *et al.,* (1971)

Table (1). Differential genotypes used to identify pathotypes of stripe rust incited by *Puccinia striiformis* f. sp. *tritici* in Egypt.

Differential cultivars	Abbreviation	Decanery value	Resistance gene	Type
GI. World differential set[1]				
Chinese 166	Ch	(2^0) =1	*Yr1*	winter
Lee	Lee	(2^1) = 2	*Yr7*	spring
Heines Kolben	HK	(2^2) = 4	*Yr2 Yr6*	spring
Vilmorin 23	V23	(2^3) = 8	*Yr3*	winter
Moro	Mo	(2^4) = 16	*Yr10*	winter
Strubes Dickkopf	Std	(2^5) = 32	*SD*	winter
Suwon 92 × Omar	Su	(2^6) = 64	*SU*	winter
Clement	Cl	(2^7) = 128	*Yr2 Yr9*	winter
Tirticum spelta Album	Sp	(2^8) = 256	*Yr5*	spring
GII. European Differential set[1]				
Hybrid 46	H46	(2^0) =1	*Yr 4*	winter
Reichersberg 42	R42	(2^1) = 2	*Yr(7)*	winter

Heines Peko	Pe	$(2^2) = 4$	*Yr2 Yr (6)*	spring
Nord Desprez	No	$(2^3) = 8$	*Yr(3)*	winter
Compair	Com	$(2^4) = 16$	*Yr8*	spring
Carstens V	CV	$(2^5) = 32$	*YrCV*	winter
Spaldings Prolific	Spa	$(2^6) = 64$	*YrSP*	winter
Heines VII	HVII	$(2^7) = 128$	*Yr2*	winter

* Johnson *et al*., (1972).

Identification of stripe rust physiologic races was achieved using the World and European group of wheat differentials according to the method of Johnson *et al*., (1972). A number of sets of 7-10 days old seedlings were inoculated, incubated and allowed to continue their growth till symptoms onset (ca 18-20 days). Then disease records were estimated using the scale of Mc Neal *et al.,* (1971) or the 0-9 scale in which (0-5) are considered resistant responses, while (6-9) are considered as susceptible one. Race nomenclature was expressed as the sum of susceptible response (HIT) of world set versus European one.

$$\text{Virulence (\%)} = \frac{\text{No. of susceptible response}}{\text{Total number of isolates}} \times 100$$

Green (1965).

Determination of gene efficacy To evaluate stripe rust resistant genes, times of resistant reaction for every monogenic line were recorded as a percentage of the total number of isolates as follow:

$$\text{Gene efficacy} = \frac{\text{No. of avirulent isolates}}{\text{Total number of isolates}} \times 100$$

RESULTS

Physiologic races and virulence frequencies.

Season 1999/2000:

Data presented in tables (2 and 3) revealed the occurrence of 9 races of stripe rust (*Puccinia striiformis* f. sp *tritici* West.). These races were 0E0, 128E65, 194E69, 210E100, 226E109, 134E109, 236E 150, 450E45 and 454E128 were determined on the basis of sum of high infection types for each of 17 wheat stripe rust monogenic differentials. Virulence frequencies were very high against *Yr*6, *Yr*7, *Yr*8, *Yr*9, *Yr*(6) and *Yr*(7), while they were very low against *Yr*1, *Yr*4, *Yr*5 and *Yr*10.

Season 2000/01:

Data presented in tables (2 and 3) revealed the occurrence of 10 races of stripe rust. These races were 0E0, 0E64, 230E150, 236E250, 435E117, 447E59, 497E85, 499E95, 505E71 and 505E119 Virulence frequencies were very high against *Yr*1, *Yr*3, *Yr*4, *Yr*5, *Yr*6, *Yr*7, *Yr*8, *Yr*9, *Yr*10, *Yr*SD, *Yr*SU, *Yr*SP, *Yr*(6) and *Yr*(7), and low against *Yr*2 and Yr(3).

Season 2001/02:

Data presented in tables (2 and 3) revealed the occurrence of 9 races of stripe rust. These races were 0E0, 0E64, 4E2, 6E134, 142E182, 116E144, 230E148, 230E150 and 240E20. Virulence frequencies were very high against *Yr2,Yr3,Yr6, Yr7, Yr8, Yr9, Yr10, YrSP, Yr(6)* and *Yr*(7), and low against *Yr*1, *Yr*4, *Yr*5, *Yr*SU and *Yr*(3)**.**

Season 2002/03:

Data presented in tables (2 and 3) revealed the occurrence of 11 races of stripe rust. These races were 0E0, 0E64, 4E16, 4E128, 6E16, 70E20, 70E26, 70E134, 70E182, 130E178 and 198E156. Virulence frequencies were very high against *Yr2, Yr6, Yr7, Yr8, YrSU, YrSP, Yr(6)* and *Yr(7),* and low against *Yr1, Yr3, Yr4,Yr5, Yr9, Yr10, YrCV, YrSD and Yr(3).*

Season 2003/04:

Data presented in tables (2 and 3) revealed the occurrence of 9 races of stripe rust. These races were 0E0, 0E64, 2E0, 4E2, 4E148, 6E1134 , 70E20, 70E134 and 230E150. Virulence Frequencies were very high against *Yr2, Yr6, Yr7, Yr8, YrSU, YrSP,*

Yr(6) and *Yr(7)*, and low against *Yr1, Yr3, Yr4, Yr5, Yr10, YrSD* and *Yr(3).*

Season 2004/05:

Data presented in tables (2 and 3) revealed the occurrence of 9 races of stripe rust. These races were 0E0, 4E0, 4E2, 64E2, 68E2, 70E154, 134E18, 189E182 and 198E151.Virulence frequencies were very high against *Yr2, Yr6, Yr7, Yr8, Yr9, YrSU* and *Yr(7),* while the lowest frequencies were found against *Yr1,Yr3, Yr4, Yr5,Yr10, YrCV, YrSD, YrSP* and *Yr(3).*

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Table 2

Table (3) Frequency of virulence of *Puccinia striiformis* f. sp *tritici* West. Against 17 monogenic lines (Yr's) for stripe rust resistance on seedling stage in 1999/00-2010/11.

	Season / race											
Yr (S)	**1999/00**	**2000/01**	**2001/02**	**2002/03**	**2003/04**	**2004/05**	**2005/06**	**2006/07**	**2007/08**	**2008/09**	**2009/10**	**2010/11**
Yr 1	0.00	32.85*	0.00	0.00	0.00	6.66	0.00	0.00	0.00	0.00	0.00	0.00
Yr 2	**11.66**	14.28	28.00	25.00	26.66	18.33	1.66	32.50	46.66	71.11	33.33	0.00
Yr 3	21.66	22.85	20.00	0.00	0.00	6.66	0.00	13.75	0.00	24.44	8..33	0.00
Yr 4	46.66	24.28	0.00	0.00	0.00	3.33	0.00	000	16.66	8.88	10.00	0.00
Yr 5	3.33	35.71	0.00	0.00	0.00	0.00	0.00	0.00	2.50	4.44	10.00	0.00
Yr 6	11.66	22.85	48.00	51.25	45.00	56.66	40.00	31.25	53.33	60.00	25.00	76.67
Yr 7	40.00	27.14	22.00	28.75	36.66	27.14	18.00	42.5	33.33	66.66	0.00	71.66
Yr 8	11.66	31.42	20.00	37.5	18.33	18.33	0.00	26.25	23.33	37.77	10.00	28.34
Yr 9	66.66	50.00	20.00	5.00	3.33	16.66	0.00	25.00	6.66	48.88	10.00	0.00
Yr 10	6.66	35.71	20.00	2.5	6.66	0.00	3.75	3.75	13.33	0.00	48.33	5.44
Yr CV	35.00	18.57	10.00	6.25	0.00	6.66	0.00	5.00	0.00	20.00	15.00	00.00
Yr SD	26.66	50.00	10.00	0.00	3.33	6.66	0.00	38.75	16.66	60.00	10.00	11.64
Yr SU	50.00	38.57	6.00	22.5	16.66	31.66	16.66	21.25	16.66	60.00	0.00	15.00
Yr SP	63.33	50.55	20.00	18.75	16.66	0.00	16.66	18.75	0.00	0.00	0.00	0.00
Yr (3)	28.33	18.57	0.00	8.75	8.33	3.33	3.33	15.66	16.66	13.33	0.00	0.00
Yr (6)	36.66	35.71	42.00	16.25	30.00	51.66	36.66	16.25	40.0	18.33	26.66	66.64
Yr (7)	11.66	35.71	42.00	16.25	30.00	51.66	33.33	16.25	20.0	20.0	20.66	00.00

* Each value was calculated by directing the times of susceptible responses by the total number of the samples for each season.

Season 2005/06:

Data presented in tables (2 and 3) revealed the occurrence of 9 races of stripe rust. These races were 0E0, 0E64, 2E0,

4E0, 4E2, 6E134, 64E6, 68E2 and 70E142 which were determined on the basis of sum of high infection types for each of 17 wheat stripe rust monogenic differentials. Virulence frequencies were very high against *Yr6, Yr7, YrSU, Yr SP, Yr(6)* and *Yr(7)*, and low against *Yr1,Yr2, Yr3, Yr4,Yr5, Yr8, Yr9,, Yr10, YrCV, YrSD* and *Yr(3).*

Season 2006/07:

Data presented in tables (2 and 3) revealed the occurrence of 6 races of stripe rust. These race were 0E0, 0E64, 2E128, 32E20, 102E22, 102E128, 142E20, 198E144, 228E148, 230E158, 230E191, 238E0, 238E182 and 494E158 which were determined on the basis of sum of high infection types for each of 17 wheat stripe rust monogenic differentials. Virulence frequencies were very high against *Yr2, Yr3,Yr6, Yr7, Yr8, Yr9, YrSD, YrSU, YrSP, Yr(6)* and *Yr(7),* and low against *Yr1, Yr4,Yr5, Yr10* and *YrCV***.**

Season 2007/08:

Data presented in tables (2 and 3) revealed the occurrence of 6 races of stripe rust. These race were 0E0, 4E0, 6E153, 16E130, 102E128 and 230E150. Virulence frequencies were very high against Yr2, *Yr4, Yr6, Yr7, Yr8, YrSD, YrSU, Yr(3),Yr(6)* and *Yr(7),* and low against Yr1, Yr3, *Yr5,Yr10, YrCV* and *YrSP*

Season 2008/09:

Data presented in tables (2 and 3) revealed the occurrence of 8 races of stripe rust. These races were 0E0, 2E128, 102E128, 174E182, 228E148, 230E191, 238E0 and 494E158. Virulence frequencies were very high against *Yr2, Yr3,Yr6, Yr7, Yr8, Yr9, YrSD, YrSU, Yr(6)* and *Yr(7),* and low against *Yr1, Yr4, Yr5,Yr10* and *YrSP*

Season 2009/010:

Data presented in tables (2 and 3) revealed the occurrence of 7 races of stripe rust. These races were 0E0, 4E0, 16E2, 16E128, 16E130, 60E153 and 60E177. Virulence frequencies were very high against *Yr2,Yr6, Yr8, Yr10, Yr (6)* and *Yr(7*), and low against *Yr1, Yr3, Yr5, Yr7, YrSU, YrSP* and *Yr(3).*

Season 2010/011:

Data presented in tables (2 and 3) revealed the occurrence of 13 races of stripe rust. These races were 0E0, 2E0, 2E16, 4E0, 6E0, 4E4, 6E4, 6E5, 6E20, 18E16, 34E20, 38E20 and 70E40. Virulence frequencies were very high against *Yr6, Yr7 Yr8* and *Yr(6)* and low against *Yr1, Yr2, Yr3, Yr4,Yr5, Yr9,YrCV, YrSP* and *Yr(3)*.

DISCUSSION

Stripe rust of wheat (*Triticum aestivum* L.) caused by *Puccinia striiformis tritici* is considered one of the most serious diseases in Egypt. The disease has became a very dangerous on most of the currently used varieties because of their susceptibility to the disease (El-Daoudi, *et al.*, 1996) . It usually occurs with higher level of severity on the late sowings than the early ones, when the environmental conditions became suitable for rust incidence and development (Mundt *et al*., 1995).

In 1967, the disease appeared on leaves and heads and destroyed a very large area of wheat plant in lower Egypt (Abd el-Hak *et. al*., 1972). Also in 1985, 1996 and 1997, it appeared at very high levels and caused high significant losses in grain yield (El-Daoudi, *et. al.* 1996). This part is a very important step in testing the genetic materials in breeding program for stripe rust resistance.

The annual survey of the disease was conducted through out 12 growing seasons of wheat crop in some governorates of Egypt gave evidence to the presence of different virulence's of the causal agent(*Puccinia striiformis tritici* West .). The results obtained were established on the comparisons of both visual symptoms as infection types of the uredial stage of the casual agent with those reported by Wiese (1977) and Agrios ((1979).

Isolation and identification of the prevailing races of the disease are an essential step to satisfy this work(Chen *et al.,* 2002). In the course of this study,

virulence survey was carried out by collecting stripe rust samples from different locations of the country for rust isolation and identification.

The obtained results in seedling stage gave evidence to presence of 114 physiologic races of stripe rust during the 12 successive seasons 1999/2000 - 2010/011. 58 races occurred during one season only whereas other 10 races occurred during two season only (2E128, 16E130, 70E120, 70E134, 70E182, 228E148, 230E191, 236E250, 230E0 and 494E158). On the other hand frequently occurred during 12 season (0E0) following 0E64 .

All identified races during seasons showed different frequencies of occurrence depending on the wheat cultivars from which the infected samples were collected Similar results were recorded by (Chen *et al*., 1995).

In general rust causal organisms are air- borne pathogens which are carried by wind from their source to the susceptible plants (Chen *et al*., 2005). Therefore, source of rust inoculums play an important role in the occurrence and frequency of virulence (Chen *et al*. , 2005).

The appearance of new virulence is due to the appearance of new mutation, hetrokaryosis and the hybridization of genetically different individuals (Stakman 1962). Stripe rust, in particular, showed high virulence occurrence variation in (Mclntosh 1992) and new virulence are appeared.

Virulence occurrence against the different stripe rust genes was also of different values depending on the host - race compatibility (Chen *et al*. , 2005).

In this study, virulence was detected to *Yr 1, Yr 5, Yr 10* and *Yr (3)* showed the low frequencies, while the frequency of virulence to *Yr 2,Yr 6, Yr 7, Yr (6), Yr(7), Yr 8* and *Yr 9* showed the highest ones. Similar results were reported by Ashmawy (2005), Ocha *et al.,* (2007), Mamluk *et al.,* (2006), Farzad Afshari (2006), Seidov *et al.,* (2006), Shahin (2008), Omara (2009), Ashmawy (2010).

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تعريف السلالات الفسيولوجية لفطر الصدأ الأصفر في مصر من موسم ١٩٩٩/٢٠٠٠ إلي موسم ٢٠١٠/٢٠١١.

ممدوح عبد المنعم عشماوي ، عبد العزيز عبد الناصر محمد أبوعلي ،
واصف عبدا لصمد يوسف ، عاطف عبد الفتاح شاهين
معهد بحوث أمراض النباتات ، قسم أمراض القمح ، مركز البحوث الزراعية ، مصر

الملخص العربي

السلالات الفسيولوجية ومدى عدوانية هذه السلالات خلال ١٢ موسم من موسم ١٩٩٩/٢٠٠٠ حتى موسم ٢٠١٠/٢٠١١ . يتم تعريف السلالات الفسيولوجية علي الأصناف المفرقة للعزلات المجمعة من الحقول المختلفة. النتائج المتحصل عليها تم تعريف ١١٤ سلالة خلال ١٢ موسم. أظهرت النتائج ٥٨ سلالة عرفت في موسم واحد فقط ثم اختفت هذه السلالات. وسلالات ظهرت في موسمين فقط وهي (2E128, 16E130, 70E120, 70E134, 70E182, 228E148, 230E191, 236E250, 230E0 and 494E158). والسلالة 0E0 ظهرت في جميع المواسم . شدة العدوانية كانت عالية علي الجينات *Yr6, Yr7, Yr8, Yr(6)* and *Yr(7)* وكانت قليلة جدا علي الجينات *Yr10* and *Yr1, Yr4, Yr5* . يمكن استخدام هذه النتائج في برنامج التربية لإنتاج الأصناف المقاومة.