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WHEAT STRIPE RUST PATHOTYPES, THEIR FREQUENCY AND VIRULENCE FORMULAE IN EGYPT DURING 2000/2001 AND 2001/2002

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ABSTRACT

Six and nine wheat stripe rust (*Puccinia striiformis tritici* West.) pathotypes viz. 0E0, 0E64, 142E182, 166E148, 230E150, 166E146 and 0E0, 0E64, 2E0, 2E128, 4E2, 6E134, 132E2, 228E20, 230E150 were identified during 2000/2001 and 2001/2002, respectively. Races 0E0, 0E64 and 230E150 were common during the two seasons. However, race 0E0 was the more frequent one followed by 0E64, 142E182 and 166E148.

The obtained results gave evidence to the superiority and distinction of *Yr's*: 10 and CV which were the best during 2001/2002 since no virulence were recorded to them. It is recommended to incorporate such genes within new released varieties and/or lines to enhance and increase resistance to stripe rust in the wheat breeding program in Egypt.

INTRODUCTION

Rusts are considered to be one of the main limiting factors affecting wheat mass production in Egypt. However, stripe rust is considered so in particular. Four critical recognizable intervals were recorded as epiphytotics *i.e.* 1967/68, 1995/996, 1997/98 and 1999/2000. On the other hand, a little bet cases of epiphytotics were recorded during 1985/86 and 1998/1999 wheat growing seasons (Abdel-Hak, *et al.* 1972, and Abu El-Naga, *et al.* 1997, 1999 and 2001).

The present work aimed to reveal the presence of stripe rust pathotypes during 2000/2001 and 2001/2002 in Egypt, taking into consideration their virulence, frequencies and the effective genes acting against rust population, to be utilized in wheat breeding program in Egypt.

MATERIALS AND METHODS

The differential varieties assigned for stripe rust physiologic race identification and their specifications are listed in Table (1). these entries included two sets i.e.. World and European viz. *Triticum spelta album*, Clement, Suwon 92 × Omar, Strubes Dikkopf, Moro, Vilmorin 23, Heines Kolben, Lee, Chinese 166 and Heines VII, Spalding Prolific, Carstens V, Compair, Nord Desprez, Heines Peko, Reichersberg 42, Hybrid 46. The set of differentials were kindly supported by Dr, El-Daoudi, Y.0H. who imported them from (IPO) the Nertherniand.

Rusted samples were collected from the susceptible vars which were sown in the Northern governorate of Egypt, *i.e.* Kafr El-Sheikh, Dakahleia and Gharbeia, in addition to certain susceptible entries involved within the wheat breeding programme.

Table (1): Wheat cultivars used to differentiate races of *Puccinia striiformis* f. sp. *tritici* and their specifications in Egypt.

No	Name	ID number	Type	Resistance gene
1	Chinese 166	CI 011765	Winter	*Yr* 1
2	Lee	CI 012488	Spring	Yr 7
3	Heines Kolben		Spring	*Yr* 6
4	Vilmorin 23	PI 125093	Winter	*Yr* 3
5	Moro	CI 013740	Winter	*Yr* 10
6	Strubes Dickkopf		Winter	*Yr* SD
7	Suwon 92 x Omar		Winter	*Yr* SU
8	Clement	PI 518799	Winter	Yr 9
9	*Tritici spleta album*	WA 005768	Inter	*Yr* 5
10	Hybrid 46	PI174655	Winter	*Yr* 4
11	Reichersberg 42		Winter	*Yr* (7)
12	Heines Peko	PI180620	Spring	*Yr* (6)
13	Nord Desprez	PI167419	Winter	*Yr* (3)
14	Compair	PI325842	Spring	*Yr* 8
15	Carstens V	PI191311	Winter	*Yr* CV
16	Spalding Prolific		Winter	*Yr* SP
17	Heines VII	PI201195	Winter	*Yr* 2

CI = Crop index number, PI= plant identification, WA= Washington state number, Yr genes designated by number (e.g. Yr I and Yr5), Have been previously named (Lupton and Macer, (1962); McIntosh, 1983; Chen and Line, 1987, 1988, 1990.

The collected samples were purified using the single pustule technique and multiplied on one or two of the following susceptible checks i.e. *Triticum dicoccum tricoccum*, Michigan amber, *Triticum spelta saharense*, Morocco, Baart, Giza 160, Little Club and Giza 160.

Seedlings of 10 day old 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 Triton-B or Tween 20, to remove the waxy layer on leaf and to increase the viscosity of the leaf surface aiming to preserve more uredospores on the leaf blade according to the methods of Stakman, *et al.* (1962) with few modifications. The spraying techniques were applied for inoculation following the methods adopted by Rowell, 1957; and Stubbes 1988, in which uredospores were suspended in mineral oil (mobile 100) or nonphytotoxic paraffinic oil *i.e.* soltrol.

The inoculated plants were incubated in humid apparatus covered with a glass plate and kept in dark for 48 hrs. at 9 °C in a room specified for this purpose. Then transferred to growth cabinet conditioned at 12/15 °C for 16/8 hrs. day/night rhythm. Irrigation, fertilization ... etc were carried out as recommended. Disease symptoms began to be visible 18-20 days after inoculation. Rust reaction was recorded thereafter following the (0-9) scale adopted by Mc Neal, *et al.* (1971).

Virulence formulae and effective resistance gene estimation were recorded following the method of Green (1966).

RESULTS

Data presented in Table (2) revealed the presence of six physiologic races of *Puccinia striiformis tritici* West. during 2000/2001. These races were identified as: 0E0, 0E64, 142E182, 166E148, 230E150 and 166E146.
Race 0E0 was avirulent to either of the tested differentials. Race 0E64 was virulent to Splading *Prolific* (SP). Race 142E182 attacked Clement, Vilmorin 23, Hienes Kolben, Lee, from the world set and Heines VII, Carstens V, Compair, Heines Peko and Reichersberg 42. Race 166E148 was virulent to Clement, Strubes Dickkopf, Heines Kolben, Lee, Heines VII, Compair, and Heines Peko. Race 230E150 was virulent to Clement, Suwan 92 × Omar, Strubes Dickkopf, Heines Kolben, Lee, Heines VII, Compair, Heines Peko and Rechersberg 42. Race 166E146 was virulent to Clement, Strubes Dikkopf, Heines Kolben, Lee Heines VII, Compair and Rechersberg 42.
As regard to the physiologic races identified during 2001/2002, data presented in Table (3) indicated the presence of 9 physiologic races *i.e.* 0E0, 0E64, 2E0, 2E128, 4E2, 6E134, 132E2, 228E20 and 230E150.

Race 2E0 was virulent to Lee (*Yr* 7). Race 2E128 was virulent to Lee and Heines VII. Race 4E2 was virulent to Hienes Kolben and Reichersberg 42. Race 6E134 was virulent to Heines Kolben, Lee, Heines VII, Heines Peko and Reichersberg 42. Race 132E2 was virulent to Clement, Heines Kolben, and Reichersberg 42. Race 228E20 was the more virulent one since it attacked Clement, Suwon 92 × Omar, Strubes Dickkopf, Heines Kolben, Compare and Heines Peko. Race 230 E150 attacked Clement, Suwon 92 × Omar, Strubes Dickkopf, Heines VII, Compare, Heines Peko and Reichersberg 42.

Concerning the potentiality of the resistant genes of stripe rust in controlling the disease, data presented in Table (4) revealed the gene efficacy by the estimation the percentage of resistant responses for 36 and 40 single isolates during the two seasons. *Yr's*:1, 5, 4 and (3) proved to be the most effective ones since they were not attacked by either of the tested isolates during the two seasons, in addition to *Yr's* 10, and CV which were superior during 2001/2002.

The rest of gene showed variable trends against the tested isolates. For example *Yr's*: 3, 10, CV, SP, showed respective efficacy *i.e.* 91.7, 88.9, 83.3 and 83.3 %. On the other hand, *Yr's* 6 (30.6%) and 8 (27.8%) were the least effective ones. This was the situation during 2000/2001.

Regarding the trend of genes during 2001/2002 *Yr's*: 3, SU, SD, 8, SP and 9 showed considerable level of resistance (more than 90% efficacy), however *Yr's* 7,6 were the least in this regard.

Regarding the virulence formulas of the identified physiologic races of 2000/2001 growing season, data in Table (5) indicated the presence of low virulence with 0E64, however race 230E150 exhibited relatively higher level of virulence. The more frequent race was 0E0 followed by 0E64 and 142E182.

Table (2): The identification of a 6 physiologic pathotypes of stripe rust (*Puccinia striiformis* West.) on 17 wheat differentials in Egypt during 2000/2001.

Enteriesnames	*Triticl spelt album*	Clement	Suwon 92 x Omar	Strubes Dickkopf	Moro	Vilmorin 23	Heines Kolben	Lee	Chinese 166	World	Heines VII	Spalding Prolific	Carstens V	Compair	Nord Desprez	Heines Peko	Reichersberg 42	Hybrid 46	Europa	Physiologic Pathotype
Abbv	Sp	Cl	Su	StD	Mo	V23	HK	Lee	Ch		HM	Spa	CV	Com	No	Pe	R42	H46	E	
Yr's	5	9	SU	SD	10	3	6	7	1		2	SP	CV	8	(3)	(6)	(7)	4		
Strength	256	128	64	32	16	8	4	2	1		128	64	32	16	8	4	2	1		
										0									0	0E0
										0		S							64	0E64
		S				S	S	S		142	S		S	S		S	S		182	142E182
		S		S			S	S		166	S			S		S			148	166E148
		S	S	S			S	S		230	S			S		S	S		150	230E150
		S		S			S	S		166	S			S			S		146	166E146

Table (3): The identification of a 9 physiologic pathotypes of stripe rust (*Puccinia striiformis* West.) on 17 wheat differentials in Egypt during 2001/2002.

Enterie-snames	*Tritici spelt album*	Clement	Suwon 92 × Omar	Strubes Dickkopf	Moro	Vilmorin 23	Heines Kolben	Lee	Chinese 166	World	Heines VII	Spalding Prolific	Carstens V	Compair	Nord Desprez	Heines Peko	Reichersberg 42	Hybrid 46	Europa	Physiologic Pathotype
Abbv	Sp	Cl	Su	StD	Mo	V23	HK	Lee	Ch		HVII	Spa	CV	Com	No	Pe	R42	H46	E	
Yr's	5	9	SU	SD	10	3	6	7	1		2	SP	CV	8	(3)	(6)	(7)	4		
Strength	256	128	64	32	16	8	4	2	1		128	64	32	16	8	4	2	1		
										0									0	0E0
										0		S							64	0E64
								S		2									0	2E0
								S		2	S								128	2E128
							S			4							S		2	4E2
							S	S		6	S					S	S		134	6E134
		S					S			132							S		2	132E2

Table (4): Stripe rust effective genes, times of resistant responses and efficacy action within physiologic races at 2000/2001 and 2001/2002 growing seasons.

Yr's	2000/2001		2001/2002	
	Resistant response	Efficacy %	Resistant response	Efficacy %
1	36	100.0	40	100.0
7	12	33.3	18	45.0
6	11	30.6	19	47.5
3	33	91.7	38	95.0
10	32	88.9	40	100.0
SD	17	47.2	37	92.5
SU	23	63.9	38	95.0
9	13	36.1	36	90.0
5	36	100.0	40	100.0
4	36	100.0	40	100.0
(7)	19	52.8	34	85.0
(6)	16	44.4	36	90.0
(3)	36	100.0	40	100.0
8	10	27.8	37	92.5
CV	30	83.3	40	100.0
SP	30	83.3	37	92.5
2	12	33.3	35	87.5

Table (5): Wheat yellow rust pathotype identity, their frequency and virulence in Egypt during 2000/2001.

No.	Pathotypes	No. of isolates	Frequency %	AV / V
1	0E0	11	31.4	1,7, 6, 3,10,SD,SU,9,5,4,(7),(6),(3),8,CV,SP,2
2	0E6 4	6	17.1	1,7,6,3,10,SD,SU,9,5,4,(7),(6),(3),8, CV,2 / SP
3	142E182	6	17.1	1,10,SD,SU,5,4,SP / 7,6,3,9(7),(6),8,CV,2
4	166E148	5	14.3	1,3,10,SU,5,4,(7),(3),CV,SP / 7,6,SD,9,(6),8,2.
5	230E150	3	8.6	1,3,10,5,4,(3), (CV),SP / 7,6,SD,SU,9,(7),(6),8,2
6	166E146	4	11.4	1,3,10,SU,5,4,(6),(3),CV,SP / 7,6,SD,9(7),8,2
Total	6	35		

The situation during 2001/2002 was quite different since races i.e. 0E0, 2E0, 0E64, 4E2 were avirulent or less virulent in comparison with the rest of tested races Table (6).

Table (6): Wheat yellow rust pathotype identity, their frequency and virulence in Egypt during 2001/2002.

No.	Pathotypes	No. of Isolates	Frequency %	AV/V
1	0E0	18	45.0	1,7, 6, 3,10,SD,SU,9,5,4,(7),(6),(3),8,CV,Sp,2
2	0E64	2	5.0	1,7,6,3,10,SD,SU,9,5,4,(7),(6),(3),8,CV,2 / SP
3	2E0	3	7.5	1,6,3,10,SD,SU,9,5,4,(7),(6),(3),8,CV,SP,2 / 7
4	2E128	3	7.5	1,6,3,10,SD,SU,9,5,4,(7),(6),(3),8,CV,SP / 7,2
5	4E2	3	7.5	1,7,3,10,SD,SU,9,5,4,(6),(3),8,CV,SP,2 / 6,(7)
6	6E134	3	7.5	1,3,10,SD,SU,9,5,4,(3),8,CV,SP / 7,6(7),(6),2
7	132E2	3	7.5	1,7,3,10,SD,SU,5,4,(6),(3),8,CV,SP,2 / 6,9,(7)
8	228E20	3	7 5	1,7,3,10,5,4,(7),(3),CV,SP,2 / 7,6,SD,SU,9,(6),8
9	230E150	2	5.0	1,3,10, 5,4,(3),CV,SP / 7,6,SD,SU,9,(7),(6),8,2
Tot.	9	40		

DISCUSSION

Wheat stripe rust (*Puccinia striiformis* West.) was known as a sporadic disease in Egypt during the elapsed decades. But with beginning of the 1990's it's occurrence seemed to be continuos every year.

The history of the disease in Egypt tills us about the presence of four critical periods of epiphytoties could be recognizable *i.e.* 1967/68, 1994/95, 1997/98 and 1999/2000. On the other hand, a little bet cases of infections were recorded during 1985 and 1998 (Abdel-Hak, *et al.* 1972; El-Daoudi *et al.* 1996, Abu El Naga *et al.* 1997, 1998, 1999, 2001). These epiphytotics were closely related to the affinity of the genetic constitutions of both the host and pathogen, in other terms between the prevalent cultivars and the dominant races of stripe rust pathogen, in addition to the availability of the environmental circumstances that fit the disease.

The present results gave evidence to the presence of 6 and 9 physiologic races of *Puccinia striiformis* West. in Egypt during 2000/2001 and 2001/2002, in respect.

The most predominant one was race 0E0. It was recorded earlier at Saudi Arabia, Algeria and Morocco during (1990-1992), Louwers, 1992. It is avirulent to either of the tested differentials. This was attributed to that the genes it attacks are not included in the differential set.

So, the differential set must be supplemented with a complementary group of monogenics (Abu El-Naga, 2000 unpublished data) Race 2E0 was recorded at IPO during 1980's as a dominant race within the Egyptian samples in addition to Turkey and Lebanon (Stubbs, 1989). It was virulent to Lee (*Yr 7*).

Race 230E150 was recorded at Saudi Arabia (Stubb, 1989) and in Egypt (unpublished data, Abu El-Naga, 2000). This race is characterized by the high virulence, since it attacked Lee, Heines Kolben, Strubes Dikkopf, Suwon 92 x Omar, Clement, Reichersberg 42, Heines Peko, Compair and Heines VII. The rest of races seemed to be new ones in Egypt.

As regard to the potentialities of *Yr* genes and it's role in resitsance, the obtained results gave evidence to the superiority and distintction of *Yr* 1, *Yr* 5, *Yr* 4, *Yr* 3 during the two seasons. However, Yr 10 and Yr CV could be added during 2001/2002. These results were quite different with those of Abu El-Naga, 2002 (unpublished data), Dehghan (2001) and Cetin *et al.* (2001) who confirmed the effectiveness of *Yr's* 6, 1, 2, 8, 7 in Egypt, *Yr's*: 2, 6, 7, 9, 18 and A in Iran and *Yr's* : 2, 6, and 7 in Turkey.

These results, were considered to be logic and reasonable, may be to the lackness of *Yr's* 1, 5, CV, 10, within the local commercials from which samples were drived. So it is better to recommend that such genes must be incorporated within our commercials since they proved to be effective in different countries other than Egypt and Nile Valley countries Eshhanov, *et al.* (2001) and Abu El-Naga *et al.* (2001), (2002) who confirmed the importance of *Yr's* 1,5 and CV as resistant genes for stripe rust.

These results are considered to be good tools for the progress and enhancement of the wheat breeding programme against stripe rust in Egypt.

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الطرز المرضية لفطر الصدأ الاصفر فى القمح وتكرارها ومدى عدوانيتها فى مصر علـى مدى موسمى ٢٠٠٠/٢٠٠١ ، ٢٠٠١/٢٠٠٢

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يتعلق هذا البحث بدراسة وتعريف السلالات الفسيولوجية لمرض الصدأ الاصفر فى القمح الذى يعتبر خطرا يهدد زراعات القمح فى مصر والعالم ، وتعتبر نتائج مثل هذا البحث مهمة من الناحية الوراثية لكل من باحث الامراض ومربى القمح وتتلخص نتائجه فى الآتى

تم تعريف ست وتسع سلالات فسيولوجيه من الفطر المسبب لمرض الصدأ الاصفر فـى القمـح المسمى *Puccinia striiformis* West. وهى 0E0, 0E64, 142E182, 166E148, 230E150, 166E146 and خلال موسمى ٢٠٠٠/٢٠٠١ ، 0E0, 0E4, 2E0, 2E128, 4E2, 6E134, 132E2, 228E20, 230E150 ٢٠٠١/٢٠٠٢ على الترتيب.

وكان اكثر هذه السلالات انتشارا 0E0, 0E64, 142E182,166E148 وقد بينت الدراسة أن جينـات المقاومه الفعالة ضد المرض كانت *Yr's*:1, 5, 4, 3 على مدى الموسمين بالاضافة للجينات *Yr's:* 10, CV خـلال الموسم الاخير حيث لم تسجل أى عدوانيه على هذه الجينات وبصفة عامة فقد تميز موسم ٢٠٠٠/٢٠٠١ بارتفاع عدوانية الطرز المعرفة عن مثيلاتها فى موسم ٢٠٠١/٢٠٠٢.

ونوصى بادخال هذه الجينات فى الاصناف العالية الانتاج والمستنبطة حديثاً فـى برنـامج التربيـة لزيـادة المقاومة ضد هذا المرض ، حيث أنها مفتقدة فى الاصناف المحلية .