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VIRULENCE AND PATHOGENICITY ASSOCIATIONS IN *PUCCINIA GRAMINIS* F. SP. TRITICI IN EGYPT DURING 1996-1998 CROP SEASONS

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Abstract

In Egypt, wheat stem rust survey gave evidence to the presence of ten races (11, 14, 15, 17, 19, 24, 34, 39, 53 and 122) in 1996, five races (10, 11, 14, 15, and 39) in 1997 and eight races (4, 10, 11, 24, 34, 39, 98 and 207) in 1998 growing seasons. Over the three years of study, races 11 and 39 were the most common representing and 31.86 % frequency, respectively.

Over the three years of study, frequency of virulence among the fifty-six identified isolates on ninteen monogenic lines was determined. The most effective gene was Gt+ exhibiting 67.88% efficacy. On the other hand, the other genes showed susceptibility for the tested isolates.

The Pathogenicity Association Coefficient (PAC) and Virulence Association Coefficient (VAC) were determined. Most of the gene pairs were effective with low PAC and VAC or nearly equal values of PAC and VAC.

INTRODUCTION

Virulence is the pathogenicity characterized by specific genetic interactions between genotypes of the host and the pathogen. A virulent isolate of a fungal pathogen is one which carries "virulence" gene which enables it to attack a particular host genotype, whereas an avirulent one cannot attacke this genotype (Russel, 1978). Virulence and occurrence of leaf rust races is monitored through annual surveys in Egypt. These data are used to estimate the relative prevalence and distribution of rust races and to detect shifts toward virulence to resistance genes being used in wheat breeding programs.

The objectives of this study were to identify the prevalent stem rust races in Egypt during 1996, 1997 and 1998 growing seasons, to characterize virulence of *P.graminis* and to determine Pathogenicity Association Coefficients (PAC) that limit the effectiveness of gene pairs conditioning resistance against stem rust pathogen populations..

MATERIALS AND METHODS

Stem rust specimens of the uredial tage were collected during the growing seasons 1995/96, 1996/97 and 1997/98. Samples were stored in a refrigerator until October when the temperature in the greenhouse was suitable for rust work. Sampling included most of the grown varieties and lines carrying single genes for stem rust resistance. Each sample was inoculated on 7-day-old seedlings of the highly susceptible wheat variety, little club. In oculation, purification, incubation and race identification were carried out according to Stakman *et al.* (1962).

Virulence analysis was carried out using differential host set consisting of nineteen monogenic lines (Table 1). A mixture of spore/talc powder (1:25 v/v) for

Table 1. Host series with known Sr genes included in the stem rust virulence survey in 1996, 1997 and 1998 growing seasons.

Sr genes	Genome location	Source	Tester
5	6DS	Reliance	ISr5-Ra
6	2DS	Red Egyptian	ISr6-Ra
7b	4BL	Marquis	TSr7b-Ra
8a	6AS	Red Egyptian	ISr8a-Ra
9b	2BL	Kenya 117A	W2691 Sr 9b
9d	2BL	Hope	Isr 9d-Ra
9e	2BL	Vernstein	Vernstein
9g	2BL	Lee	CnSSr 9g
11	.6BL	Lee	ISr 11-Ra
17	7BL	Renown	Cs(Hope 7B)
21	2AL	*T. monococcum*	Einkorn
24	3DL	*A.elongatum*	Bt Sr 24A9
25	7DL	" "	LC Sr 25Ars
26	6AL	" "	Eagle
27	3A	Imperial rye	W2691 Sr 27
29	6DL	Etiole de Choisy	Pusa Sr 29 Edch
30	5DL	Webster	Bt Sr 30 Wst
36	2BS	*T.timopheevi*	W2691 Sr Tt-1
Gt+	-	Gaumt	Bt Sr Gt Gt

each pure culture was dusted onto the primary leaves of 7-day-old differential host set. Infection types were recorded 10-12 days after inoculation, on a 0-4 scale (Stakman *et al.*, 1962). Infection types 0,0; (fleck) 1 and 2 indicated resistant reaction and infection types 3 and 4 denoted susceptible reactions. The efficacy of the *sr* genes was determined according to Samborski and Dyck (1976). Pathogenicity Association

Coefficient (PAC) and Virulence Association Coefficient (VAC) were, also, calculated using equation proposed by Browder and Eversmyer (1977) in which:

$$PAC_{A:B} = \frac{\text{No. of isolates } (A_A:A_B) + (\text{No. of isolates VA:VB})}{\text{Total No. of isolates in samples}}$$

$$PAC_{A:B} = \frac{\text{No. of isolates } V_A:V_B}{\text{Total No. of isolates in samples}}$$

Where PAC = Pathogenicity Association Coefficient.

VAC = Virulence Association Coefficient.

A = Avirulent

V = Virulent

A and B = Varieties

RESULTS AND DISCUSSION

Table (2) represents the collectively ten physiologic races of *Puccinia graminis f. sp. tritici*, namely, 11,14,15,17,19,24, 34, 39, 53, and 122 in 1995/96; Five races i.e. 10, 11, 14, 15, 39 in 1996/97 and Eight races namely 4,10,11,24,39,98, and 207 in 1997/98 growing season. Over the three years of study. races 11 and 39, were the most common representing 32.22% and 31.86% frequency, respectively. El-Daoudi *et al.* (1994a) identified 7 and 6 races in 1990 and 1991 growing seasons, respectively. Races 11 and 34 were the most frequent in both seasons. The results show that, some of the present races were previously identified by Abdel-Hak *et al.* (1982) and El-Daoudi *et al.* (1994b) in Egypt and other Near East countries. They attributed the occurrence of certain races within the Nile Valley in addition to Yemen to the migration of such races via the wind. Also, tracing rust movement between neighboring countries may explain the epidemiologica. aspects and help in the advance of breeding program through the exchange of breeding materials in these countries.

Data in Table (3) reveal the efficacy of nineteen stem rust resistance genes assigned in Egypt during, 1996-1998. These data indicate that Sr's Gt+and 30 and Sr's 26, 27, 24, 29, 36 and 25 prove to be effective against the tested isolates during 1996, 1997, and 1998 growing seasons. If the three seasons are considered, it could be said that, Sr Gt+ was the most effective exhibiting 67.86% effectiveness. El-Daoudi *et al.* (1994a) reported that, Sr's 9e, 26, and to some extent Sr 27 proved their effectiveness against stem rust populations during both 1990 and 1991 seasons. Moreover,

Table 2. Physiologic races of *Puccinia graminis* f.sp. *tritici* and their frequencies % in 1996, 1997 and 1998 growing seasons.

Physiologic races*	Race frequency%/Season					
	1995/96		1996/97		1997/98	
	No. of isolates	Frequency%	No. of isolates	Frequency%	No. of isolates	Frequency%
4	-	-	-	-	1	2.70
10	-	-	1	05.0	1	2.70
11	39	35.46	9	45.0	6	
14	11	10.00	1	05.0		16.2
15	9	08.18	5	25.0	-	-
17	24	21.82	-	-	-	-
19	13	11.82	-	-	-	-
24	2	01.82	-	-	1	2.70
34	1	00.91	-	-	1	2.70
39	9	08.18	4	20.0	25	67.6
53	1	00.91			-	-
98	-	-	-	-	1	2.70
122	1	00.91	-	-		
207	-	-	-	-	1	2.70
Total	110	100	20	100	37	100

*Races were identified according to Stakman et.al., 1962

Table 3. Virulence of the 1996 and 1997 wheat stem rust (*Puccinia graminis f.sp.tritici*) isolated in Egypt to 19 Sr genes and their effectivenes %.

Sr genes	Growing seaon 1995/96			Growing seaon 1996/97			Growing seaon 1997/98			Mean		
	No.of virulent isolates	Frequency %	Gene efficacy %	No.of virulent isolates	Frequency %	Gene efficacy %	No.of virulent isolates	Frequency %	Gene efficacy %	No.of virulent isolates	Frequency %	Gene efficacy %
5	91	82.73	17 .27	16	80	20	34	91.89	08.11	47	83.93	16.07
6	86	78.18	21.82	15	75	25	36	97.30	02.70	46	82.14	17.86
7	77	70.00	30.00	20	100	-	23	62.16	37.84	40	71.43	28.57
8	84	76.36	23.64	16	80	20	34	91.89	08.11	45	80.36	19.64
9	85	77.27	22.73	19	95	5	28	75.68	24.32	44	78.57	21.43
9	42	38.18	61.82	20	100	-	34	91.89	08.11	32	57.14	42.86
9	98	89.09	10.91	20	100	-	33	89.19	10.81	50	89.29	10.71
9	87	79.09	20.91	19	95	5	33	89.19	10.81	46	82.14	17.86
11	89	80.91	19.09	15	75	5	35	94.59	05.41	46	82.14	17.86
17	105	95.45	4.55	20	100	-	29	78.38	21.62	51	91.07	08.93
21	103	95.64	4.36	19	95	5	35	94.59	05.41	52	92.86	07.14
24	88	80.00	20.00	13	65	35	11	29.73	70.27	37	66.07	33.93
25	104	95.54	5.46	18	90	10	13	35.14	61.86	45	80.36	19.64
26	84	76.36	23.64	15	75	25	1	02.70	97.30	33	58.93	41.07
27	101	91.82	8.18	20	100	-	2	05.41	94.59	41	73.21	62.79
29	84	76.36	23.64	19	95	5	11	29.73	70.27	38	67.86	32.14
30	84	76.36	23.64	8	40	60	26	70.27	29.73	39	69.64	30.36
36	97	88.18	11.82	18	90	10	11	29.73	70.27	42	75.00	25.00
Gt	32	29.09	70.91	6	30	70	17	45.95	54.05	18	32.14	67.86

the results obtained by El-Daoudi *et al.* (1994b) gave evidence to the increasing resistance of Sr's 30,5,26,24, Gt+, 7b and 8a during 1992-1994 in the Nile Valley countries. whereas a considerable decrease was found with Sr's 9e, 26, 27 and 36 in these countries in addition to Yemen and Syria (Abdel-Hak et al., 1982; El Daoudi *et al.*, 1987 & 1994b and Abu El-Naga et al., 1990). In Egypt, Sr genes 6, 11, 9e, 22,24, 26, and 27 were effective against stem rust races during 1960, 1965 (Abdel-Hak *et al*, 1982). El-Daoudi *et al.* (1987) found that Sr's 24, Gt+29, 26, 27, 36 and Sr 9e were effective against stem rust populations at both seedling and adult stages. Abu El-Naga *et al.* (1990) indicated that the genes Sr's 9e, 27, 26, 8a, and Sr 24 were effective during 1987/88; while Sr's Gt+,26,9e, 27, 22, and 36 were effective during 1988/89.

On the other hand, the obtained result revealed a higher frequency of virulence, over the three years, to Sr 21 (92.86%), Sr 17 (91.07%), Sr 9e (89.29%), Sr 5 (83.93), Sr 6 (82.14) and Sr 8a (80.36). In 1989-91 growing season, high virulences and susceptibilities were observed with Sr's 30, 11, 8a, 24, 37 (El-Daoudi et al., 1994b). The authors attributed this to the existence of these resistance genes in the commercial varieties from which the tested isolates were collected.

Virulence analysis of the three years of study revealed 110, 20, and 37 virulence formulae during 1996, 1997, and 1998, growing seasons, respectively (Tables 5, 6 and 7).

The Pathogenicity Association Coefficient (PAC) and Virulence Association Coefficient (VAC) data obtained from the Pathoginicity Association analysis consist of 171 PAC and VAC of the combinations of nineteen host genes for low reaction, over the three years of study, are presented in Table (4). Most of the gene pairs are effective with low PAC and VAC or nearly equal values of PAC and VAC, Which is recommended to be used in the Egyptian wheat program to give a long term resistance.

Table 4. Pathogenicity Association Coefficient (PAC) and Virulence Association Coefficient (VAC).

Sr genes		Sr6	Sr7b	Sr8a	Sr9b	Sr9u	Sr9e	Sr9g	Sr11	Sr17	Sr21	Sr24	Sr25	Sr26	Sr27	Sr29	Sr30	Sr36	SrGt+
Sr5	PAC	0.03	0.03	0.03	0.03	0.03	0.04	0.03	0.03	0.05	0.06	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.05
	VAC	0.02	0.02	0.02	0.02	0.03	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.03	0.02	0.02	0.02	0.02	0.05
Sr6	PAC		0.03	0.03	0.03	0.03	0.05	0.04	0.04	0.05	0.06	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.05
	VAC		0.02	0.02	0.02	0.03	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.03	0.02	0.02	0.02	0.02	0.05
Sr7b	PAC			0.04	0.04	0.04	0.06	0.04	0.04	0.07	0.09	0.03	0.04	0.03	0.04	0.03	0.03	0.04	0.05
	VAC			0.02	0.02	0.02	0.01	0.02	0.02	0.01	0.01	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.04
Sr8a	PAC				0.03	0.03	0.05	0.04	0.04	0.06	0.07	0.03	0.04	0.03	0.03	0.03	0.03	0.03	0.05
	VAC				0.02	0.03	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.05
Sr9b	PAC					0.03	0.05	0.04	0.04	0.06	0.09	0.03	0.04	0.03	0.03	0.03	0.03	0.04	0.05
	VAC					0.03	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.04
Srgd	PAC						0.08	0.06	0.06	0.10	0.12	0.04	0.05	0.04	0.04	0.04	0.04	0.04	0.04
	VAC						0.01	0.01	0.01	0.01	0.01	0.02	0.01	0.02	0.01	0.02	0.02	0.01	0.03
Srge	PAC							0.03	0.03	0.04	0.04	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.05
	VAC							0.02	0.02	0.02	0.02	0.02	0.02	0.03	0.02	0.02	0.02	0.02	0.05
Sr9g	PAC								0.04	0.05	0.06	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.05
	VAC								0.02	0.02	0.02	0.02	0.03	0.02	0.02	0.02	0.02	0.02	0.05
Sr 11	PAC									0.05	0.06	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.05
	VAC									0.02	0.02	0.02	0.02	0.03	0.02	0.02	0.02	0.02	0.05
Sr17	PAC										0.04	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.05
	VAC										0.02	0.03	0.02	0.03	0.03	0.02	0.02	0.02	0.05
Sr 21	PAC											0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.05
	VAC											0.03	0.02	0.03	0.02	0.02	0.02	0.02	0.05
Sr24	PAC												0.05	0.03	0.04	0.04	0.04	0.04	0.05
	VAC												0.02	0.02	0.02	0.02	0.02	0.02	0.04
Sr 25	PAC													0.03	0.03	0.03	0.03	0.03	0.05
	VAC													0.02	0.02	0.02	0.02	0.02	0.05
Sr26	PAC														0.04	0.04	0.04	0.04	0.04
	VAC														0.01	0.02	0.02	0.01	0.03
Sr 27	PAC															0.03	0.03	0.04	0.05
	VAC															0.02	0.02	0.02	0.04
Sr29	PAC																0.04	0.04	0.05
	VAC																0.02	0.02	0.04
Sr 30	PAC																	0.04	0.05
	VAC																	0.03	0.03
Sr36	PAC																		0.05
	VAC																		0.04

Table 5. Avirulence/virulence formulae, based on seedling reactions, for 102 isolates of *Pucceinia graminis* f.sp. *tritici* .

Egyptian stem rust isolates (ES)	Standard race	Avirulence/ virulence formulae	Virulence freuen-cy%
ES 11-1	11	0 /	100
ES 11-2	11	9e/	94.74
ES 11-3	11	9g/	94.74
ES 11-4	11	29/	94.74
ES 11-5	11	Gt+/	94.74
ES 11-6	11	7b,9e/	89.47
ES 11-7	11	9e,29/	89.47
ES 11-8	11	9e,Gt+/	89.47.
ES 11-9	11	7b,Gt+/	89.47
ES 11 -10	11	9g,36/	89.47
ES11-11	11	8a,9e/	89.47
ES 11-12	11	8a,21,Gt+/	84.21.
ES11-13	11	9e,26,Gt+/	84.21
ES 11-14	11	9e,24,Gt+/	84.21
ES 11-15	11	9e,26,29/	84.21
ES 11-16	11	9e,29,Gt+	84.21
ES 11-17	11	9e,21,24/	84.21
ES11-18	11	5,8a,9e,Gt+/	78.95,
ES 11-19	11	9e,24,26,Gt+/	78.95
ES11-20	11	6,9b,21,36+/	78.95
ES 11-21	11	5,21,36,Gt+/	78.95
ES 11-22	11	6,7b,9e,11/	78.95
ES 11-23	11	8a,9d,9e,9g,24/	73.68
ES 11-24	11	7b,8a,9b,9e,9g/	73.68
ES 11-25	11	9e,11,24,25,Gt+/	73.68
ES 11-26	11	8a,9e,9g 24,Gt+/	73.68
ES 11-27	11	7b,9e,25 26,Gt+/	73.68
ES 11-28	11	8a,9e,24,29,30,Gt+/t	68.42
ES 11-29	11	8a,9d,24,27,29,Gt+/	68.42
ES 11-30	11	7b,9e,24,26,29,30/	68.42
ES 11-31	11	7b,9e,11,26,29,Gt+/	68.42
ES 11-32	11	7b,9e,9b,26,27,Gt+/	68.42
ES 11-33	11	8a,7b,9e,9b,24,29,Gt+	68.42
ES 11-34	11	5,6,9b,9d,24,29,30,G+/	63.17
ES 11-35	11	7b, 9e/	57.90
ES 14-1	14	6,9e,9b,Gt+/	89.47
ES 14-2	14	9e,9b,17,Gt+/	78.95
ES 14-3	14	7b,8a,9e,Gt+/	78.95.
ES 14-4	14	7b,9e,9d,26,Gt+/	78.95
ES 14-5	14	8a,9e,26,36,Gt+/	73.68
ES 14-6	14	6,7b,9e,9d,30,Gt+/	73.68
ES 14-7	14	6,7b,8a,9e,9d,30,Gt+/	68.42
ES 14-8	14	6,7b,9e,9d,9b,11,30,Gt/	63.16
ES 14-9	14	7b,9e,9b,9d,25,26,29,36,Gt+/	57.90
ES 14-10	14	9e,9d,11,24,26,27,30,36,Gt+/	52.63
ES 14-11	14	O	52.63
ES 15-1	15	8a/	100
ES 15-2	15	Gt+/	94.74
ES 15-3	15	Gt+/	94.74
ES 15-4	15	21,24/	94.74
ES 15-5	15	11,9b/	89.47
ES 15-6	15	9e,26,Gt+/	89.47
ES 15-7	15		84.21

Table 5. Cont.

Egyptian stem rust isolates (ES)	Standard race	Avirulence/ virulence formulae	Virulence freuency%
ES17-1	17	0 /	100.00
ES17-2	17	26,Gt+/	89.47
ES17-3	17	9e,Gt+/	89.47
ES174	17	6,Gt+/	89.47
ES17-5	17	9d,Gt+/	89.47
ES 17-6	17	7b,9e,Gt+/	84.21
ES17-7	17	9d,24,26/	84.21
ES 17-8	17	9b,30,G+/	84.21
ES17-9	17	7b,9e,Gt+/	84.21
ES17-10	17	7b,26,29,Gt+/	78.95
ES17-11	17	5,9e,29,Gt+/	78.95
ES17-12	17	7b,9e,9b,11,29/	73.68
ES17-13	17	9e,9b,9d,26,Gt+/	73.68
ES17-14	17	9e,11,26,27,30,Gt+/	68.42
ES17-15	17	5,7b,9e,29,30,Gt+/	68.42
ES17-16	17	5,6,8a,9g, 24,36,G+t/	63.16
ES17-17	17	6,9e,9b,9d,9a,11,36/	63.16
ES17-18	17	5,7b,9e,24,26,29,30,Gt+/	57.90
ES17-19	17	5,6,9e,9d,26,30,36,Gt+/	57.90
ES 17-20	17	5,6,9e,11,27,30,36,Gt+/	57.90
ES17-21	17	5,7b,9e,9g9d,8a,11,17/	57.90
ES 17-22	17	5,9e,9b,9d,26,27,30,36,Gt+/	52.63
ES 19-1	19	9e,Gt+/	89.95
ES19-2	19	9b,11,30,Gt+/	78.95
ES19-3	19	6,7b,27,Gt+/	78.95
ES 19-4	19	6,9e,9b,Gt+/	78.95
ES19-5	19	6,7b,9e,9b,Gt+/	73.68
ES 19-6	19	8a,9e,9b,27,Gt+/	73.68
ES 19-7	19	8a,9e,9b,27,Gt+/	73.68
ES 19-8	19	7b,9e,11,24,30,Gt+/	68.42
ES 19-9	19	6,8a,7b,9e,24,Gt+l	68.42
ES 19-10	19	8a,9d,11,21,29,Gt+/	68.42
ES19-11	19	5,8a,9b,9e,26,27,29,30,Gt+/	52.63
ES19-12	19	5,6,9e,9d,8a,24,29,30,Gt+/	52.63
ES 19-13	24	5,6, 7b,9e,9b,9a, 11,24,30,36,Gt+/	52.63
ES 24-1	24	9e, 25,26,30, Gt+/	42.11
ES 24-2	39	9e,6,24,25,Gt+/	73.68
ES 39-1	39	8a,Gt+/	73.68
ES 39-2	39	8a,24,Gt+/	89.47
ES 39-3	39	7b,9e,Gt+/	84.21
ES 39-4	39	8a,11,Gt+/	84.21
ES 39-5	39	5,7b,9e,Gt+/	84.21
ES 39-6	39	8a,9d,11,21,Gt+/	78.95
ES 39-7	39	7b,8a,9e,11,17,24/	73.68
ES 39-8	39	9e,9g,11,17,24,27/	68.42
ES 39-9	39	5,6,7b,9e,9b,9g,11,24,30,36,Gt+/	68.42
ES 53-1	53	5,6,7b,9b,9d,11,17,21,29,Gt+/	42.11
ES 53-2	53	5,6,7b,9b,9d,9e,11,24,29,30,36/	42.37
ES 122-1	122	6,7b,9e,Gt+/	78.95

Table 6. Avirulence/virulence formulae, based on seedling reactions, for 19 isolates of *Puccinia graminis f.sp. tritici* in Egypt during 1997.

Egyptian stem rust isolates (ES)	Standard race	Avirulence/ virulence formulae	Virulence freuency%
ES 10-1	10	5,6, 11,21,24,25,26,29,30,Gt+/	47.37
ES 11-1	11	30,Gt/	89.95
ES 11-2	11	6,30/	89.95
ES 11-3	11	24,26/	89.95
ES 11-4	11	6,30,Gt+/	84.21
ES 11-5	11	9g,25,30,36/	78.95
ES 11-6	11	9d,26,30,Gt+/	78.95
ES 11-7	11	5,11,26,Gt+/	78.95
ES 11-8	11	6,8a,24,30,Gt+/	73.68
ES 14-1	14	5,Gt+/	89.47
ES 15-1	15	Gt+/	94.74
ES 15-2	15	5 /	94.74
ES 15-3	15	36/	94.74
ES 15-4	15	24,30,Gt+/	84.21
ES 15-5	15	6,8a,11,30/	78.95
ES 39-1	15	24,Gt+/	89.47
ES 39-2	39	8a,11,Gt+/	84.21
ES 39-3	39	8a,9b,24,30,Gt+/	73.68
ES 39-4	39		73.68

Table 7. Avirulence/virulence formulae, based on seedling reactions, for 36 isolates of *Puccinia graminis f.sp. tritici* in Egypt during 1996.

Egyptian stem rust isolates (ES)	Standard race	Avirulence/ virulence formulae	Virulence freuency%
ES 4-1	4	24,25,26,27/	78.95
ES 10-1	10	25,26,27,29,36/	73.68
ES 11-1	11	25,26,27/	84.21
ES 11-2	11	7b,17,26,27,29/	73.68
ES 11-3	11	24,25 26,27,36/	73.68
ES 11-4	11	7b,24 25,26,27,29,36,Gt+/	57.90
ES 11-5	11	7b,9b,11,24,25,26,27,Gt+/	57.90
ES 11-6	11	7b,11,24,25,26,27,29,30,36,Gt+/	46.37
ES 24-1	24	7b,24,25,26,27,30,36,Gt+/	57.90
ES 34-1	34	6,7b,8,24,25,26,27,29,30,36,Gt+/	42.11
ES 39-1	39	26,271	89.47
ES 39-2	39	24,26,27/	84.21
ES 39-3	39	7b,26,27,36/	78.95
ES 39-4	39	25,26,26,Gt+/	78.95
ES 39-5	39	24,26,27,36/	78.95
ES 39-6	39	5,21,26,27,26,30/	73.68
ES 39-7	39	9B,26,27,29,39/	73.86
ES 39-8	39	24,26,27,36,Gt+/	73.68
ES 39-9	39	2b,21,25,27,29/	73.68
ES 39-10	39	24,25,26,27,29,36/	68.42
ES 39-11	39	9d,25,26,27,36,Gt+/	68.42
ES 39-12	49	24,25,26,27,36,Gt+/	68.42
ES 39-13	39	9,24,26,27,29,36 /	68.42
ES 39-14	39	24,25,26,27,36,Gt+/	68.42
ES 39-15	39	7b,24,25,26,27.29,36/	63.19
ES 39-16	39	16,24,25,26,27,36,Gt+/	63.19
ES 39-17	39	24,26,27,29,30,36,Gt+/	63.19
ES 39-18	39	9b,9e,9g,26,27,29,30/	63.19
ES 39-19	39	9b,17,24,26,27,29,36,Gt+/	57.90
ES 39-20	39	5,7b,24,25,26,27,29,30,Gt+/	52.63
ES 39-21	39	7b,24,25,26,27,29,30,36,Gt+/	52.63
ES 39-22	39	8a,9b,9d,17,24,26,27,29 ,36,Gt+/	42.11
ES 39-23	39	7b,9e,17,24,25,26,27,29,30,Gt+/	47.37
ES 39-24	39	7b,8a,9d,9e,9g,17,24,25,26,29/	47.37
ES 98-1	98	5,7b,9b,24,25,26,27,29,30,36,Gt+/	42.11
ES 207-1	207	7b,9b,9e,9g,17,24,25,26,29,30,36,Gt+/	36.84

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الشراسة والقدرة المرضية في فطر بكسنيا جرامينس في مصر خلال الفترة من ١٩٩٦ - ١٩٩٨

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تهدف الدراسه الي تقدير الشراسة والقدرة المرضية لفطر بكسنيا جرامينس مسبب مرض صدا الساق في القمح في مصر خلال ثلاثة مواسم زراعية (١٩٩٦ - ١٩٩٨) ضد ١٩ عامل وراثي مقاوم لهذا المرض.

وقد أظهرت النتائج المتحصل عليها مايلي:-

١. أظهرت نتائج الحصر السنوي لفطر صدأ الساق في مصر عن وجود عشرة سلالات فسيولوجية خلال الموسم الزراعى١٩٩٥ / ١٩٩٦ وهى السلالة ١١ ،١٤، ١٥، ١٧، ١٩ ، ٢٤، ٣٤، ٣٩، ٥٣ ، ١٢٢ كذلك وجود خمسة سلالات (سلالة ١٠ ، ١١، ١٤، ١٥، ٣٩) خلال الموسم الزراعي ٩٦ / ١٩٩٧ م وكذلك ثمانية سلالات وهي سلالات ٤، ١٠، ١١، ٢٤، ٣٤، ٣٩، ٩٨ ، ٢٠٧ في الموسم ٩٧ / ١٩٩٨م .

٢. كانت السلالات ١١، ٣٤ هي الأكثر سيادة علي مدار ثلاث مواسم بمعدل تكرار ٣٢,٢٢٪ و ٣١,٨٦ ٪ علي التوالي.

٣. علي مدي الثلاث أعوام أيضا درس معدل تكرار القدره المرضية لخمسة وستين عزلة علي ١٩ عامل وراثي للمقاومة لمرض صدأ الساق وكان العامل الوراثي +Gt هو الأكثر مقاومة ضد العزلات المختبرة بكفاءة ٦٧,٨٨٪ في حين أظهرت العوامل الأخري قابلية للأصابة.

٤. عند دراسة معامل القدرة المرضية ومعامل الشراسة المرضية اتضح أن معظم أزواج العوامل الوراثية معا كانت فعالة حيث أظهرت انخفاضا لكلا المعاملين.