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HOST RANGE OF *Pyricularia grisea* AND 10-YEAR DEVELOPMENT OF NEW RICE BLAST RACES

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ABSTRACT

Rice blast disease is one of the important diseases in Egypt as well as in most of the rice growing countries. This study was conducted to clarify the host range of this disease in Egypt. Isolation of the causal organism of rice blast disease *Pyricularia grisea* was obtained from some rice commercial cultivars i.e. Giza 171, Giza 176, Reiho and the susceptible check variety Giza 159, from both Sakha and Gemmiza experimental farms. Also, some isolates were obtained from different weeds collected from rice growing governorates during 1999 and 2000 seasons. Eight rice isolates were identified as 6 races on the international differential varieties, while fifteen weed isolates were identified as 4 races. Some weeds were found to serve as secondary hosts for rice blast fungus, i.e. *Cyperus rotundus* L., *Cyperus alopecuroides* R. Ottb., *Echinochloa crus-galli* L. Beauv., *Echinochloa colona* L. Link., *Elusine indica* L. Gaern., *Dinebra retroflexa* Panz., *Panicum repens* L., *Leersia hexandra* Sw., *Digitaria nodosa* Parl., *Setaria verticillata* L. Beauv. and *Paspalum distichum* L. The identified isolates of rice race groups were IB (37.5%), IC (25%), IG (25%) and ID (12.5%), while the identified weed races were IG-1 (6.6%), IB (26.7%) and ID (6.7%). All rice physiological races were able to infect the susceptible rice cultivars, as well as some new resistant cultivars as; Sakha 104, Sakha 101, Giza 177, Giza 181 and Giza 182 and some weeds during 1999 and 2000. While some weed races were able to infect their original hosts and some old susceptible rice cultivars. Also, some weed races were able to infect other weeds besides their original hosts. Some new virulent and specific blast races to rice cultivars Sakha 104 and Sakha 101 were appeared and caused a breakdown of resistance genes of both cultivars. Some races were virulent to Sakha 104 cultivar only, and the other specific for infecting Sakha 101. While some races able to infect both cultivars and the other were avirulent to the same cultivars during the period from 1999 to 2008.

Keywords : Blast disease, *Pyricularia grisea,* Host range, Races, weeds, Rice cultivars.

INTRODUCTION

Blast, casued by *Pyricularia grisea* (Cooke) Sacc. {synonym *Pyricularia oryzae* Cavara, teleomorph *Magnaporthe grisea* (Hebert) Barr; Rossman *et al.*, 1990}, is a serious disease of rice. The fungus also parasitizes more than 50 other species of grasses and sedges, many of which are common weeds in rice fields (Ou, 1985).The host range of a pathogen is important in disease management, since the field grasses may serve as subsidiary hosts for the causal organism. The host range may also play an important role in the variability of this fungus, as some isolates of *P. grisea* from some grasses may have the ability for completing mating type with some isolates from rice to produce the perfect stage (Mekwatanakarn *et al.*, 1999). Populations of the fungus from weeds epidemiologically could be an important source of inoculum for some rice cultivars (Mackill and Bonman , 1986). *P. grisea* infects some weeds such as, i.e. *Cyperus rotundus* L., *Echinochloa crus-galli* L. Beauv., *Echinochloa colona* L. Link., *Elusine indica* L. Gaern., *Dinebra retroflexa* Panz., *Panicum repens* L., *Leersia hexandra* Sw., *Digitaria nodosa* Parl., *Setaria spp, Paspalum distichum* L. (Suzuki and Hashimoto 1953, Asuyama 1963, Yaegashi 1977, Borromeo et al., 1993). Cross infection was found among different weed isolates and some rice varieties , Johnson (1954) reported that isolate of *P. oryzae* from *E. crus-galli* was slightly to moderatlely pathogenic to certain rice varieties and isolate from *Digitaria sanguinalis* is pathogenic to rice varieties such as Caloro and Colusa. Kamel (1975) reported that *Pyricularia oryzae* can not infect all the tested species of *Cyperus* (*Cyperus rotundus, C. alopeuroides, C.difformis*) and on the other hand is capable of infecting *Echinochloa crus-galli, E. colona* and *Setaria glucan* . It was also capable of infecting crab grass (*Digitaria sanguinalis*) inducing circular brown spots. He added that *Pyricularia* isolated from *Digitaria* was capable of infecting its own host, and *E. crus-galli* . and *E. colona* but not rice. *Pyricularia* from *E. crus-galli* and *E. colona* were capable of infecting its own hosts, *E. crus-galli* and rice plants. *Pyricularia* from *Digitaria* or *E. crus-galli* did not attack *E. colona*, while *P. oryzae* is capable of infecting *E. crus-galli* and *E. colona*. Mackill and Bonman (1986) reported that some grasses were not susceptible to *Pyricularia grisea* from rice although isolates from those grasses readily infected their original hosts. They indicated also that rice cultivars were susceptible to isolates from *Echinochloa colona* and *Leersia hexandra*. Similarly, *E. colona* was susceptible to some isolates originating from rice. Srinivas *et al.* (1998) reported that the rice blast fungus *Pyricularia grisea* was isolated from two weed hosts, *Digitaria ciliaris* and *D. marginata* which were severely infected with blast and pathogenicity was confirmed. On cross inoculation to rice plants, typical blast symptom was observed. By inoculating the international differential varieties, the race of weed hosts was found to be identical to that of rice (IC-12) which infects rice plant. There are two kinds of field evidence to indicate the existence of physiologic races of *Pyricularia oryzae*. The first is the breakdown of disease resistance of a variety in a given location and the second is the great differences in varietal reaction according to varied locations, Chiu *et al.* (1965). The daughter conidia of *Pyricularia oryzae* from monosporodial culture could also be separated into many pathogenic races and differ from each other in pathogenicity to rice varieties and physiological characteristics, (Giatgong and Frederiksen ,1969 and Ou and Nugue ,1970). The frequency of spontaneous mutation, in which a fungus strain previously avirulent to a cultivar, becomes virulent to it, Katsuya and Kiyosawa (1969). Many pathogenic races of Pyricularia oryzae may occur in a blast nursery at any time of the year. The kind and frequency of these races vary greatly. This may explain why cultivars showing a resistant reaction in one test may become susceptible in another. Quamaruzzaman and Ou (1970). In Egypt, Sehly *et al.* (1993) used 8 international differential varieties to identify races of 60 isolates of Pyricularia oryzae collected during three consecutive years. Five race groups, were identified in the three seasons, including IC, ID, IG, IH and II. Races identified in 1989 were IG (35%), IH1 (30%), IC29 and IC25 (20%), ID5 (10%) and II (5%). In 1990 season, ID13 and ID15 represented 55% of the isolates; IC17, IC25 and IC29 (40%) and IH1 (5%). In 1991 season, ID13 and ID15 represented 40% of the isolates; IH1 (25%), IG1 (20%), IC3, IC13 and IC21 (15%). Sehly *et al.* (2000) inoculated forty five isolates of Pyricularia grisea to the eight international differential varieties. The most of common races identified were IH-1 (36.6%), ID race group (17.8%), IA race group (13.3%), IG-1 (13.3%) and the avirulent race group II (9%). As a result of high race shifting and big change in prevalence of specific races for highly susceptible old rice cultivars; Giza 159 and Reiho were escaped from the disease in some locations in 2005 season and became resistant. Also, the cultivars Sakha 101 and Sakha 104 were resistant through 1994 up to 2002, except through 1997 up to 1999, Sakha 104 was infected in one or all locations with 2-4 blast score . Starting from 2003 and 2004, the resistance was broken down in some locations and the cultivars were completely susceptible in 2005 up to 2007 seasons due to appearance of specific virulent races for the two cultivars. IB-45 was a specific race for Sakha 104, while IG-1 for Sakha 101, the race shifting was coupled with the extension of the cultivated areas of those cultivars, whereas , these races were appeared when the cultivated area by both cultivars covered 75% of the total Sehly *et al.*, (2008). The main objective of this study is to investigate whether some grasses in Egypt serve as collateral hosts for *P. grisea* and keep the fungus survive through the off-season when rice is not grown.

MATERIALS AND METHODS

Blast sample collections from rice and weeds :

Eight isolates of *P. grisea* were isolated from rice cultivars during 1999 season from Kafr El-Sheikh and Gharbia, while 15 isolates were obtained from different weeds in 1999 and 2000 seasons, from Kafr El-Sheikh, Gharbia, Beheira and Sharkia governorates. Rice blast isolates were obtained from samples of Giza 171, Reiho, Giza 176 and Giza 159, while weed isolates were obtained from *Cyperus rotundus* L., *C. alopecuroides* R. Ottb., *Elusine indica* L., *Echinochloa colona* L. Link.,*E. crus-galli* L. Beauv., *Dinebra retroflexa* Panz., *Paspalum distichum* L., *Panicum repens* L., *Setaria verticillata* L. Beauv., *Digitaria nodosa* Parl. and *Leersia hexandra* Sw.

In another trail the same rice varieties were evaluated under artificial inoculation with different races of blast fungus which isolated from Sakha 101, Sakha 104 and some differential varieties during 2002 to 2008. All races were collected from different locations.

Isolation method of the causal organism :

Sporulation was induced on infected rice leaves by overnight incubation in petri dishes at 25°C and 100% relative humidity under continuous fluorescent light. Single conidium isolates were generated by streaking conidia from sporulating lesions on 2% water agar (WA) for ~ 24 hr, then the germinated single conidia were picked and transferred to water agar for another 24 hr. The tip of single hyphae was cut and grown on banana dextrose agar medium on a piece of sterile filter paper disc. When the filter papers were completely occupied by the fungal growth, the paper discs were individually transferred into petri dishes. About one week later, the dried filter paper having the fungus isolates were cut into small pieces. Pieces obtained from each isolate were altogether introduced into a plastic vial and kept at -20°C for a long-term storage (Mekwatanakarn *et al.*, 1999).

Pathogenicity, race identification and cross infection :

Pathogenicity test, race identification studies and cross inoculation were carried out for the obtained isolates. Eleven commercial rice varieties. 11 weeds and 8 international differential varieties (IDV) (Atkins *et al.*, 1967) were included for evaluation under greenhouse condition in each test for each isolate. Each tray was planted with 29 entries having Giza 159 as a susceptible check variety. Seedlings were ready for inoculation at 3-4 leaf stage, about 3-4 weeks after sowing. For spore production, isolates were grown on banana dextrose agar medium (200 g banana, 15 g glucose, 15 g agar/1000 ml water). 100 ml of spore suspension was prepared from each isolate and adjusted to $5x10^4$ spores/ml, gelatin was added to the inoculation in concentration of 2.5 g/L (Bastiaans, 1991) to enhance the adhesion of spores on leaf surfaces. Each isolate was sprayed using electrical spray gun. The inoculated seedlings were held in a moist chamber with at least 90% R.H. and 25-28^{o} for 24 hr, and then moved to the greenhouse. Seven days after inoculation, the reaction of tested entries to blast was scored.

Disease assessment :

Blast reaction for greenhouse studies was recorded according to the Standard Evaluation System for Rice, IRRI (1996): a 0-9 scale as follows :

0 = no lesions;
1 = small brown specks of pinhead size;
2 = larger brown specks;
3 = small, roundish to slightly elongated necrotic gray spots. 1-2 mm in diameter, with a brown margin;
4 = lesions elliptical with a gray center and brown margin, 1-2 cm long. < 2% of leaf area damage;
5 = lesions < 10% of the leaf area;
6 = lesions 10-25% of the leaf area;
7 = lesions 26-50% of the leaf area;
8 = lesions 75% of the leaf area;
9 = more than 75% of the leaf area died.

Reactions 1,2 = Resistant (R) Reaction 3 = Moderately resistant (MR)
Reactions 4-6 = Susceptible (S) Reactions 7-9 = Highly susceptible (HS)

RESULTS AND DISCUSSION

Isolation of the causal organism of blast disease :

Infected rice samples with blast disease were collected from different rice cvs. from Sakha and Gemmiza during 1999 season. Results in Table (1) show that 8 isolates were successfully purified by a single spore technique and gave *Pyricularia grisea*. These isolates were identified as 6 races on the international differential varieties. Fifteen isolates from infected weeds were collected in 1999 and 2000 seasons and identified as four races (Table 2). Isolation of *P. grisea* from rice, graminaceous and nongraminaceous weeds were in the line with earlier investigators as Asuyama (1963), Yaegashi (1977), Mackill and Bonman(1986), Borromeo *et al.*(1993), Mekwatanakarn *et al.* (1999).

Table (1): Races of P. grisea identified from diseased rice samples collected from different locations and cultivars in 1999 season

Isolate number	Governorate	District	Source of sample (Variety)	Race
1	Gharbia	Gemmiza	Giza 171	IG-1
2	"	"	Reiho	IB-45
3	"	"	Giza 176	IB-45
4	"	"	Giza 159	ID-1
5	Kafr El-Sheikh	Sakha	Giza 171	IC-1
6	"	"	Reiho	IC-5
7	"	"	Giza 176	IG-1
8	"	"	Giza 159	IB-13

Table (2): Races of P. grisea identified from diseased weed samples collected from different locations and weeds in 1999 and 2000 season

Isolate number	Governorate	District	Source of sample (Host)	Race
9	Gharbia	Gemmiza	*Cyperus rotundus*	IG-1
10	"	"	*Cyperus alopecuroides*	IG-1
11	"	"	*Echinochloa colona*	IG-1
12	Beheira	El-Rahmania	*Elusine indica*	ID-13
13	Sharkia	Abu-Kabeer	*Elusine indica*	IG-1
14	Gharbia	Mehalet Rouh	*Elusine indica*	IG-1
15	Kafr El-Sheikh	Beiala	*Elusine indica*	IG-1
16	"	Sakha	*Echinochloa crus-galli*	IB-57
17	"	"	*Dinebra retroflexa-2*	IG-1
18	"	"	*Dinebra retroflexa-1*	IB-61
19	"	"	*Digitaria nodosa*	IB-57
20	Gharbia	Gemmiza	*Panicum repens*	IG-1
21	"	"	*Paspalum distichum*	IB-61
22	"	"	*Leersia hexandra*	IG-1
23	"	"	*Setaria verticillata*	IG-1

Pathogenicity test and race identification :

1- Rice isolates :

The virulence of the obtained isolates was determined by the inoculation of each individual isolate on ten commercial rice cvs. in addition to the susceptible check variety Giza 159. Results in Table (3) show that the eight rice isolates were virulent to the old commercial rice cv. Giza 171 and the susceptible check cv. Giza159, while Giza 176 was susceptible to only 5 isolates. However, only the isolate No. 6 (identified as race IC-5) was virulent to Sakha 101, while isolates No. 4 and 5 (races ID-1 and IC-1) were virulent to Giza 178, isolates No. 1, 5, 7 (races IG-1, IC-1 and IG-1) were virulent to Giza 177, isolates No. 2, 4, 5 and 6 (races IB-45, ID-1, IC-1 and IC-5) were virulent to Sakha 104. On the other hand, no isolates were able to infect the cv. Sakha 103 (Table3).The reaction of the eight isolates on the differential varieties is presented in Table (4). Data show that the eight isolates collected from different rice cvs. were identified as 6 races, i.e. two isolates from each of IB-45 and IG-1 and one isolate from each of IB13, IC-1, IC-5 and ID-1. This reaction of international differential varieties and the ability of infection to some new commercial cultivars revealed high level of variability among rice isolates. These results are in agreement with the findings of Kamel (1975),Ou (1975), Sehly *et al.*(1993 and 2000). They reported a wide variation among isolates of *P. grisea* in Pathogenicity to rice varieties and identified many pathogenic races belonging to different race groups.

Table (3): Reaction of commercial rice cvs. to some *P. grisea* rice isolates collected from Sakha and Gemmiza, 1999 and 2000 seasons.

No.	Variety	Location / Isolate number / Race / Infection type							
		Gemmiza				Sakha			
		1	2	3	4	5	6	7	8
		IG-1	IB-45	IB-45	ID-1	IC-1	IC-5	IG-1	IB-13
1	Giza 171	S	S	S	S	S	S	S	S
2	Giza 176	MR	MR	MR	S	S	S	S	S
3	Giza 177	S	R	R	R	S	R	S	R
4	Giza 178	R	R	R	S	S	R	R	R
5	Sakha 101	R	R	R	R	R	S	R	R
6	Sakha 102	R	R	S	R	S	R	R	R
7	Sakha 103	R	R	R	R	R	R	R	R
8	Sakha 104	R	S	R	S	S	S	R	R
9	Giza 181	R	S	R	R	R	S	R	R
10	Giza 182	R	S	R	R	R	S	S	R
11	Giza 159	S	S	S	S	S	S	S	S

1-2 = Resistant (R), 3 = Moderately Resistant (MR) and 4-6 = Susceptible (S)

Table (4): Reaction of international differential varieties to rice isolates of P. grisea for race identification

No.	International differential varieties	Isolate number / International race no./ Infection type							
		1	2	3	4	5	6	7	8
		IG-1	IB-45	IB-45	ID-1	IC-1	IC-5	IG-1	IB-13
1	Raminad Str.3	R	R	R	R	R	R	R	R
2	Zenith	R	S	S	R	R	MR	R	S
3	NP-125	R	R	R	R	S	S	R	S
4	Usen	R	S	S	S	R	S	R	S
5	Dular	R	R	R	S	R	S	R	R
6	Kanto 51	MR	R	R	S	S	MR	R	R
7	CI 8970 S	S	S	S	S	S	S	S	S
8	Caloro	S	S	S	S	HS	S	S	S

1-2 = Resistant (R), 3 = Moderately Resistant (MR) and 4-6 = Susceptible (S)

2- Weed isolates :

a- Weed isolates of race group IG-1 :

The fifteen isolates of *P. grisea* isolated from different weeds in 1999 and 2000 seasons were inoculated on the source weed and other weeds in the study, beside 10 commercial cvs. and the susceptible check variety Giza 159. Out of the 15 isolates of *P. grisea* isolated from different weeds, 4 races were identified, Tables (5). The most common race was IG-1 (10 isolates), two isolates from each of IB-57 and IB-61 were found, and only one was identified as ID-13.

Among the 10 isolates identified as IG-1, 8 isolates were virulent to the susceptible cvs. Giza 159 and 7 on Giza 171, Table (5). Two isolates i.e. No. 10 and No. 14 which were obtained from *Cyperus alopecuroides* and *Elusine indica* were avirulent to the susceptible and resistant commercial cultivars; Giza 171, Giza 176, Giza 159, Giza 177, Giza 178, Giza 181, Giza 182, Sakha 101, Sakha 102, Sakha 103 and Sakha 104

Table (5): Reaction of commercial rice cultivars to some weed isolates of P. grisea belonging to race IG-1

No.	Variety	Isolate number / Race / Infection type									
		9	10	11	13	14	15	17	20	22	23
		IG-1	IG-1	IG-1	IG-1	IG-1	IG-1	IG-1	IG-1	IG-1	IG-1
1	Giza 171	S	R	S	S	R	R	S	S	S	S
2	Giza 176	R	R	S	MR	R	R	S	S	S	R
3	Giza 177	R	R	R	R	R	R	R	R	R	R
4	Giza 178	R	R	R	R	R	R	R	R	R	R
5	Sakha 101	R	R	R	R	R	R	R	R	R	R
6	Sakha 102	R	R	R	R	R	R	R	R	R	R
7	Sakha 103	R	R	R	R	R	R	R	R	R	R
8	Sakha 104	R	R	R	R	R	R	R	R	R	R
9	Giza 181	R	R	R	R	R	R	R	R	R	R
10	Giza 182	R	R	R	R	R	R	R	R	R	R
11	Giza 159	S	R	S	S	R	S	S	S	S	S

1-2 = Resistant (R), 3 = Moderately Resistant (MR) and 4-6 = Susceptible (S)

b- Weed isolates of other race groups :

Data in Table (6) indicated that the five weed isolates identified as IB-57, IB61 and ID-13 were all pathogenic to the susceptible cvs. Giza 171 and Giza159.However, Giza 176 was susceptible to 4 isolates (2 of each of IB-57 and 61).The blast-resistant commercial cultivars Giza 177, Giza 178, Sakha 101, Sakha 102, Sakha103,Sakha104, Giza 181 and Giza 182 were resistant to all tested races.The 15 isolates of *P. grisea* collected from different weeds have the ability to infect the old commercial rice cultivars but not the new ones. This may be due to the low spectrum of virulence of weed isolates to all resistance genes in the new commercial rice cultivars.

Cross infection between rice and weed isolates on different rice cultivars and weeds :

1- Rice isolates :

Results in Table (7) indicated that the cultivars Giza 171 and Giza 159 were susceptible to all tested rice blast races, while Giza 176 was susceptible to all tested races from Sakha, while it was susceptible to IB-45 and ID-1 at

Gemmiza. All tested races obtained from rice were avirulent to *Cyperus rotundus* and *Cyperus alopecuroies*, while *Echinochloa colona* was susceptible to all tested races except IB-45 and IG-1 (isolates No. 2 and 7),*Echinochloa crus-galli* was only susceptible to IC-1, IC-5 and IB-13 (No. 5, 6 and 8). Results also revealed that races of Sakha had a wider spectrum of virulence to different weeds than those of Gemmiza, i.e. IC-1 was virulent to 12 of 14 tested hosts, and IC-5 was virulent to 10 hosts. IG-1 (No. 1) isolated from Giza 171 at Gemmiza was virulent to 3 out of 14 hosts, while IB-45 from Reiho (at Gemmiza) was virulent to 6 only. The only avirulent race to all tested weeds was IG-1 (isolate No. 7) which was isolated from Giza 176 at Sakha.

Table (6): Reaction of commercial rice cvs. to some weed P. grisea isolates belonging to different race groups

No.	Variety	Isolate number / Race / Infection type				
		16	19	18	21	12
		IB-57	IB-57	IB-61	IB-61	ID-13
1	Giza 171	S	S	S	S	S
2	Giza 176	S	S	S	S	R
3	Giza 177	R	R	R	R	R
4	Giza 178	R	R	R	R	R
5	Sakha 101	R	R	R	R	R
6	Sakha 102	R	R	R	R	R
7	Sakha 103	R	R	R	R	R
8	Sakha 104	R	R	R	R	R
9	Giza 181	R	R	R	R	R
10	Giza 182	R	R	R	R	R
11	Giza 159	S	S	S	S	S

1-2 = Resistant (R), 3 = Moderately Resistant (MR) and 4-6 = Susceptible (S)

Table (7): Reaction of different rice and weed hosts to eight rice isolates of P. grisea collected during 1999 season

No.	Rice cultivars and weeds	Location/Isolate number / Source of sample (Variety) / Reaction							
		Gemmiza				Sakha			
		1	2	3	4	5	6	7	8
		Giza 171	Reiho	Giza 176	Giza 159	Giza 171	Reiho	Giza 176	Giza 159
1	Giza 171	+	+	+	+	+	+	+	+
2	Giza 176	-	-	+	+	+	+	+	+
3	Giza 159	+	+	+	+	+	+	+	+
4	*Cyperus rotundus*	-	-	-	-	-	-	-	-
5	*Cyperus alopecuroides*	-	-	-	-	-	-	-	-
6	*Echinochloa colona*	+	-	+	+	+	+	-	+
7	*Echinochloa crus-galli*	-	-	-	-	+	+	-	+
8	*Dinebra retroflexa*	-	+	-	-	+	+	-	-
9	*Digitaria nodosa*	-	+	-	-	+	+	-	-
10	*Elusine indica*	-	-	-	-	+	+	-	-
11	*Setaria verticillata*	-	-	-	+	+	-	-	+
12	*Leersia hexandra*	-	-	-	+	+	+	-	-
13	*Paspalum distichum*	-	+	-	-	+	-	-	+
14	*Panicum repens*	-	+	-	-	+	+	-	-
	International race	IG-1	IB-45	IB-45	ID-1	IC-1	IC-5	IG-1	IB-13

- Resistan and + Susceptible

2- Weed isolates :

Results in Table (8) indicated that the susceptible cultivars, i.e. Giza 171 and Giza 159 were susceptible to all tested weed races except isolate No.10 (IG-1 obtained from *Cyperus alopecuroides*), while Giza 176 was susceptible to all tested isolates except isolates No.9,10,13-15 and 23. *Cyperus rotundus* and *C. alopecuroides* were only susceptible to their original isolates (No. 9 and 10). Also, *Elusine indica*, *Leersia hexandra*, *Paspalum distichum* and *Panicum repens* were resistant to all tested weed isolates except their original isolates. Each of *Echinochloa colona, Echinochloa crus-galli, Digitaria nodosa* and *Dinebra retroflexa* were susceptible to 8 isolates (No.11,12,13,14,15,16,18 and 19). *Setaria verticillata* was resistant to all the tested isolates except No.22 & 23. Concerning the reaction of weed isolates on different rice cvs. i.e. Giza 171,Giza 176 and Giza 159, isolate No.10 (IG-1) was avirulent to three tested cvs., while isolates No. 11, 12, 16, 18, 19, 20 and 22 were virulent to the three cultivars. However, isolates No.9,13,14,15 and 23 were virulent to Giza 171 and Giza 159 only.

Effect of source and location on dominance of races :

Data in Table (9) and Fig. (1) indicated that four race groups were identified from rice, i.e. IB, IC, ID and IG, while 3 race groups were isolated from weeds, i.e. IB, ID and IG. The most common races from rice were race group IB which represented 37.5% out of total races, IC race group represented 25% collected only from Kafr El-Sheikh. ID race group represented 12.5% collected from Gharbia only and IG-1 race represented 25% of the total, 12.5% from Kafr El-Sheikh and 12.5% from Gharbia. On the other hand,the most common weed race group was IG had represented 66.6% out of total, 46.6% from Gharbia, 13.3% from Kafr El-Sheikh and 6.7% from Sharkia followed by IB race group with 20.0% from Kafr El-Sheikh and 6.7% from Gharbia. ID represented 6.7% isolated from Beheira. The virulence of rice isolates was higher than that of weeds. This was indicated by the capability of rice isolates to attack more resistant genes.

Fig. (1). The dominance of *P.grisea* races from rice and weeds

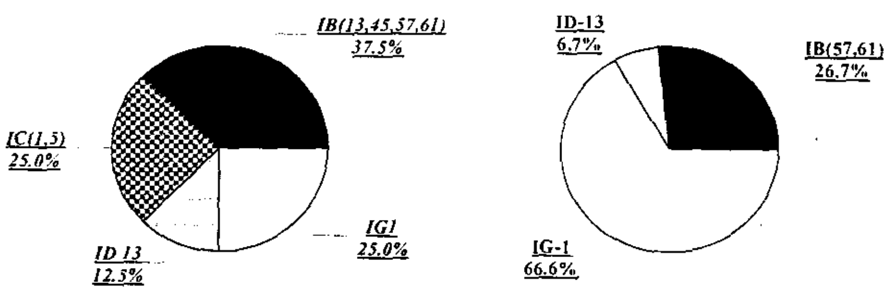

Table (8): Reaction of different rice and weed hosts to 14 weed isolates of P. grisea collected during 1999/2000 seasons

No.	Rice cultivars and weeds	Location/ Isolate number / Source of sample (host)											
		Gemmiza			El-Rahmania	*	Sakha			Gemmiza			
		9	10	11	12	13-15	16	18	19	20	21	22	23
		C. rotun.	*C. alopec*	*E. colona*	*E. indica*	*E. indica*	*E. crus.*	*D. retro.*	*D. nodosa*	*P. repens*	*P. disti.*	*L. hexan*	*S. vertic.*
1	Giza 171	+	-	+	+	+	+	+	+	+	+	+	+
2	Giza 176	-	-	+	+	-	+	+	+	+	+	+	-
3	Giza 159	+	-	+	+	+	+	+	+	+	-	+	+
4	*Cyperus rotundus*	+	+	-	-	-	-	-	-	-	-	-	-
5	*Cyperus alopecuroides*	+	+	-	-	-	-	-	-	-	-	-	-
6	*Echinochloa colona*	-	-	+	+	+	+	+	+	-	-	-	-
7	*Echinochloa crus-galli*	-	-	+	+	+	+	+	+	-	-	-	-
8	*Dinebra rotroflexa*	-	-	+	+	+	+	+	+	-	-	-	-
9	*Digitaria nodosa*	-	-	+	+	+	+	+	+	-	-	-	-
10	*Elusine indica*	-	-	-	+	+	-	-	-	-	-	-	-
11	*Setaria verticillata*	-	-	-	-	-	-	-	-	-	-	+	+
12	*Leersia hexandra*	-	-	-	-	-	-	-	-	-	-	+	-
13	*Paspalum distichum*	-	-	-	-	-	-	-	-	-	+	-	-
14	*Panicum repen*	-	-	-	-	-	-	-	-	+	-	+	-
	International race	IG-1	IG-1	IG-1	ID-13	IG-1	IB-57	IB-61	IB-57	IG-1	IB-61	IG-1	IG-1

- Resistant and + Susceptible , * Isolate No. 13 from Abu-Kabeer, Isolate No. 14 from Mehalet Roh and Isolate No. 15 from Beiala

Table (9). Effect of source and location on the dominance of races of *P. grisea* collected from rice and weeds

Race	Rice isolates %			Weed isolates %				
	Kafr El-Sheikh	Gharbia	Total (%)	Kafr El-Sheikh	Gharbia	Beheira	Sharkia	Total (%)
IB(13, 45, 57, 61)	12.5 *	25.0	37.5	20.0**	6.7	-	-	26.7
IC (1, 5)	25.0	-	25.0	-	-	-	-	-
ID 13	-	12.5	12.5	-	-	6.7	-	6.7
IG 1	12.5	12.5	25.0	13.3	46.6	-	6.7	66.6
Total	50	50	100	33.3	53.3	6.7	6.7	100.1

* Out of 8 isolates and ** Out of 15 isolates

Some weed isolates are only virulent to their original hosts , others may infect their original hosts beside some other weeds and old commercial rice cultivars.These results are in agreement with findings obtained by Kamel (1975), Mackill and Bonman (1986), Srinivas *et al.* (1998).

Race shifting of rice blast disease during 2002-2008 in Egypt :

Before 2002 season, some isolates of rice blast can infected sakha 101 and sakha 104 cultivars under artificial inoculation only, but in 2002 for the first time, some isolates overcome the resistance of the two cultivars in some locations as; sakha and Damanhour. The infection symptoms was appeared as individual typical type 4 lesions. In 2003, the two cultivars became completely susceptible and the resistance be broken down due to appearance of some specific races for this cultivars and caused some levels of losses. In 1999 and 2000, Infection of some isolates; IB-45, IC-1, IC-5 and ID-1 to the two cultivars under artificial inoculation recorded an early prediction to susceptibility and brokendown of these cultivars and the fungus finally capable to broken the resistant genes, Table (3). In 1999 and 2000, race IB-45 which isolated from cultivar Reiho in Gemmiza infected Sakha 104 (Japonica type) in addition to Giza 181 and Giza 182 (Indica type) under artificial inoculation. In 2004, this race again caused the brokendown of the same cultivar Sakha 104 under open field condition and the build up and distribution on large scale take a period and extend from 1999 to 2004, Table (10). Races IB-55 (Sakha 104) and IC-31 (Sakha 101) were isolated for the first time from sakha blast nursery and showed type 4 lesions on the same two cultivars.

Some races was specific to infect one cultivar and some specific for another, race IG-1(sakha 101- Damanhour) exhibited specific reaction to Sakha 101, while IB-45 (Sakha 104- Sakha) specific to infect Sakha 104, on the other hand, some races infected both cultivars; ID-15 (Sakha 101- Itai EL-Barod), IC-16 (Kanto 51-Sakha), IB-63 (Aichi Asahi-Sakha), IB63 (Sakha 101-Kafr EL-Sheikh), and IH-1 (Sakha 101- Shobrakhit). Also, some races completely avirulent to both cultivars; IB-37 (Toride 1-Gemmiza), IH-1 (CO39-Sakha), and IH-1 (BL1- Gemmiza), Table (10). These results indicated that the period from 1999 to 2008 exhibited high race shifting and big change in prevalence of specific races. The rice blast fungus has a wide range of variability. These results were in agreement with findings obtained by (Chiu *et al.* ,1965; Katsuya and Kiyosawa, 1969, Giatgong and Frederiksen ,1969 and Ou and Nugue, 1970, Quamaruzzaman and Ou, 1970, Sehly *et al.*, 1993, Sehly *et al.* , 2000 and Sehly *et al.*, 2008)

Table (10): Reaction of commercial rice cultivars to some rice isolates of P. grisea from 2002 to 2008 seasons.

No.	Year	Isolates of 2002-2008		2002	20003	2004		2005	2006			2007			2008		
	Race	Sakha 101*	Sakha 104*	IB-55	IC-31	IG-1	IB-45	ID-15	IH-1	IC-16	IB-63	IF-1	IH-1	IB-37	IB-63	IB-19	IH-1
	Variety			Sakha 104	Sakha 101	Sakha 101	Sakha 104	Sakha 101	CO39	Kanto 51	Aichi asahi	Shin 2	BL1	Toride 1	Sakha 101	Sakha 104	Sakha 101
1	Giza 171	S	S	S	S	S	S	S	S	S	S	S	HS	S	HS	HS	S
2	Giza 176	S	S	S	S	S	S	HS	R	S	S	S	HS	S	HS	R	S
3	Giza 177	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
4	Giza 178	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
5	Sakha 101	HS	S	R	S	HS	R	HS	R	S	S	S	MR	R	HS	R	HS
6	Sakha 102	R	R	R	R	R	R	R	R	R	R	R	S	R	R	R	R
7	Sakha 103	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
8	Sakha 104	R	HS	S	R	R	HS	S	R	S	R	R	R	R	S	S	R
9	Giza 181	R	R	R	R	R	R	R	R	R	S	R	R	R	S	R	S
10	Giza 182	R	R	R	R	R	R	R	-	-	-	-	-	-	-	-	-
11	Giza 159	S	R	S	S	S	S	S	R	R	S	S	HS	R	S	R	S
Locatioon				Sakha		Beheira	Sakha	Itai	Sakha			Gemmiza			Kafr EL-Sheikh		Shobra khit

1-2 = Resistant (R), 3 = Moderately Resistant (MR) and 4-6 = Susceptible (S), - not tested
*isolated from sakha 101 or sakha 104

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المدي العوائلي لفطر اللفحة وتطور سلالته خلال عشر سنوات

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يعتبر مرض اللفحة من أهم أمراض الأرز فى مصر ودول العالم الأخرى المنتجة لـــه. ولقد أجريت هذه الدراسة لتحديد المدى العوائلى لهذا المرض في مـــصر. تـــم عـــزل المـــسبب المرضى *Pyricularia grisea* لمرض اللفحه فى الأرز من الأصناف التجارية المنزرعة وهى جيزه ١٧١ ، جيزه ١٧٦ ، ريهو بالإضافة إلى صنف المقارنة جيزه ١٥٩ من حقول التجارب فى منطقتي سخا و الجميزة وكما عزل المسبب المرضى من مجموعة مختلفة مـــن الحـــشائش مـــن المحافظات المختلفة لزراعة الأرز فى موسمى ١٩٩٩،٢٠٠٠ وتم تعريف ثمـــاني عـــزلات مـــن أصناف الأرز المصابة الى ٦ سلالات فسيولوجية على الأصناف العالمية المفرقة بينمـــا عرفـــت عزلات الحشائش الخمسة عشرة الى ٤ سلالات فسيولوجية.ووجد أن بعض الحشائش تعمل كعوائل ثانوية للفطر *P. grisea* المسبب لمـــرض اللفحـــة وهـــى الـــسمار الحلـــو*alopecuroides* ، *Cyperus* الـــسعد *Cyperus rotundus*، الدنيبـــة*Echinochloa crus-galli*، أبـــو ركبة*Echinochloa colona*، نجيـــل النمـــر*Dinebra rotroflexa*، النـــسيلة*Panicum repens*، نجيـــل *Leersia hexandra*، دفيـــره *Digitaria nodosa*، دفـــره *Setaria verticillata* ، والمديد *Paspalum distichum*.وكانت مجاميع سلالات الفطر المعزولة من أصـــناف الأرز تتبـــع الـــسلالات الفـــسيولوجية*IB* تمثـــل (٣٧,٥%)،*IC* (٢٥%)،*IG* (٢٥%)و *ID*(١٢,٥) بينما كانت مجاميع سلالات الفطر من الحشائش تتبع الـــسلالات الفـــسيولوجية *IG-1* (٦٦,٦%)،*IB*(٢٦,٧%)، *ID*(٦,٧%). كانت جميع عزلات الأرز قادرة على إصـــابة أصـــناف الأرز الحساسة إلي جانب بعض الأصناف الحديثة مثل سخا ١٠١ ، سخا ١٠٤ ، جيـــزه ١٧٧ ، جيزه ١٨١ وجيزه ١٨٢ وبعض الحشائش بينما كانت عزلات الحشائش قادرة علي إصابة عائلهـــا الأصلي فقط وبعض أصناف الأرز القديمة الحساسة ، كما كانت بعض عزلات الحـــشائش قـــادرة على إصابة حشائش أخرى بجانب عائلها. ظهرت بعض السلالات المتخصصة لإصابة الـــصنف سخا ١٠٤ و الصنف سخا ١٠١ مما أدت إلي كسر جينات المقاومة لهذه الأصناف وكانت بعـــض السلالات قادرة علي إصابة سخا ١٠٤ فقط والبعض الأخر متخصص لإصابة سخا ١٠١ وأيـــضا هناك سلالات قادرة علي إصابة كلا الصنفين والبعض الأخر غير قـــادر علـــي إصـــابة أي مـــن الصنفين وذلك خلال الفترة من ١٩٩٩ إلي ٢٠٠٨ .