

1 Efficiency of ~~some~~ selected fungicides on blast and blight of ~~the~~ rice leaves

3 **Abstract.** The effect of pathogens on grains is closely related to the severity of the disease on
4 plants. Similarly, infection of leaves is very important in epidemic of blast and blight.
The
5 objective of this study is to provide a treatment program suitable to different fungicides to
6 protect the leaves of rice plants throughout the vegetative phase against blast and leaf blight,
7 by determining the required dose and the duration of protection for each fungicide.

8 The results showed that *Pyricularia oryzae* is drastically inhibited, on the leaves of rice at a
9 300 ppm dose of ~~the~~ Carboxin + Thiram combination, whereas *Helminthosporium oryzae* ~~is-~~
~~was~~
10 not completely inhibited at a dose of 750 ppm. However, this product causes a total leaf
11 yellowing. So this is not recommended, especially since it requires repeated applications.

12 Furthermore, Pyrazophos has no effect on *Helminthosporium oryzae* even at very high doses.
13 However, this product completely inhibits *Pyricularia oryzae* at a dose of 750 ppm. To
14 protect against rice leaf blast throughout the vegetative phase, the product should be applied
15 every two weeks.

16 On the other hand, the 750 ppm Tricyclazole totally inhibits the severity of
Pyricularia
17 *oryzae* on rice leaves. whereas, a dose of 1500 ppm of the product ~~is~~ was required to achieve
the
18 same level of protection against *Helminthosporium oryzae*. ~~If~~ When this product ~~is~~ was
combined with
19 Mancozeb, the *H. oryzae* ~~is~~ was completely inhibited at 750 ppm.

20 Furthermore, Mancozeb inhibits ~~radically~~ both pathogens at a dose of 1000 ppm. However, ~~if~~
21 ~~the~~ when Mancozeb ~~must be~~ was applied each week to protect rice leaves until the end of the
vegetative
22 phase, a single application of Tricyclazole or a combination Tricyclazole + Mancozeb
23 continues to protect rice leaves ~~respectively~~ against *P. oryzae* and *H. oryzae* until
the emergence of panicles.

24 A treatment program with the most effective fungicides is then established taking account
25 into the duration of rice plants protection throughout the vegetative phase against blast and
26 leaf blight. This calendar is distributed as follows: ??

27 Foliar from the sixth week either by: One treatment with Tricyclazole at 750 ppm against
P.
28 *oryzae* or Tricyclazole + Mancozeb ~~to~~ at 750 ppm related to *H. oryzae*; One application
every
29 15 days by the Pyrazophos at 750 ppm against *P. oryzae*;

30 **Introduction.**

31 The fungal diseases, such as the blast caused by *Pyricularia oryzae* and the blight caused by
 32 *Helminthosporium oryzae* are among the most danger for the rice culture in the world,
 33 including Morocco. Indeed, in this country, there are many studies and works ~~which were~~
 34 ~~interested that have been reported on to~~ the rice foliar diseases (Ennaffah, 1999; Hassikou, 2000;
 35 Tajani, 2000, Tajani *et*
 36 *al.*, 2001; Serghat *et al.*, 2002; 2005a; 2005b; Bahous *et al.*, 2008).

37 As many of ~~the~~ other fungal diseases, the control of these two fungi ~~is was~~ classically
 38 established
 39 by fungicides (Lawrence *et al.*, 2001; Serghat *et al.*, 2004; Bahous, 2006, Suzuki *et al.*, 2010;
 40 Kunova *et al.*, 2014). Since the incidence of both pathogens on grains is associated to the
 41 severity of the disease on plants (Nyvall *et al.*, 1995), the infection of leaves ~~is was~~ very
 42 important
 43 in the epidemics of the blast and leaf blight (long *et al.*, 2001). Consequently, it is important
 44 to treat the leaves of rice against these two pathogens to reduce the quantity of aerial
 45 inoculum resulting from necrosed and sporulated lesions or to prevent the grains from being
 46 infected if there is transmission from panicles to grains in a systematic way (Manandhar *et*
 47 *al.*, 1998a, 1998b).

48 The objective of this study ~~is was~~ to determinate the required dose and duration of protection
 49 for
 50 each fungicide in the aim to realize a program of treatment by various fungicides able to
 51 protect the rice leaves, during all the vegetative stages against the blast and leaf blight.

49 Materials and methods

50 1-Fungal material.

51 The isolates FK1 of *Pyricularia oryzae* and Hot of *Helminthosporium oryzae*, isolated
 52 respectively from the foliar lesion of the varietiesKenz and Triumph of rice were cultivated
 53 on a grain rice flour medium during 15 days.

54 When the cultures ~~cover??~~ the Petri dishes, the surface that was full with spores was scraped by
 55 a metallic spatula. The mycelium was put in sterile distilled water, then filtered through
 56 muslin tissue. The concentration of the obtained ~~sporale~~ spore suspension was adjusted, with
 57 ~~the~~
 58 distilled water containing 0.02 % ~~of~~ Tween 20 and 0.5 % ~~of~~ gelatin, to 10⁵ spores / mL.

58 2-Treatment of rice leaves

59 ~~The~~ Rice grains of the Triumph variety, very sensitive to the pathogens *P. oryzae* and *H.*
 60 *oryzae* (Ennaffah *et al.*, 1999; Ouazzani Touhami *et al.*, 2000) were disinfected by soaking in
 61 ~~the~~ 0.6 % Of sodium hypochlorite ~~during for~~ ten minutes, then rinsed ~~strictly in the~~
 62 with sterile
 63 distilled water. After 24h of drying, grains were placed in Petri dishes containing ~~some~~ sterile
 64 cotton imbibed with distilled water. After 75h of incubation in 28°C in the darkness, the
 65 ~~obtained~~ seedlings were planted in pots containing ~~the~~ soil of the forest Mamora. Then, they
 66 were watered with ~~the~~ tap water until the required stage for the inoculation (plant with 3 or 4
 67 leaves).

67 2.1-Fungicides and used doses

68 Seven fungicides were used in this test (Tricyclazole, Carboxine + Thirame, Pyrazophos,
69 Mancozèbe, Thiabendazole, Benomyl and Methylthiophanate). Every fungicide was tested ~~in~~
70 ~~the~~ at concentrations of 300, 750, 1000, 1500 and 2000 ppm.

71 2. 2- Plants treatment

72 Three types of treatments were conducted and each treatment was the subject of 15
73 repetitions:

74 * Plants inoculated with the ~~sporale??~~ suspension, (10^5 spores / mL), of each pathogen.
They
75 constitute the positive control (diseased).

76 * Plants, treated only by water, constitute the negative control (healthy).

77 * Plants treated by fungicides were then inoculated, 24 hours later, by the ~~sporale??~~
suspension
78 (10^5 spores/mL) of the tested pathogens.

79 All the plants were placed in ~~the conditions of~~ the laboratory, ~~during for~~ 48 hours, under
black
80 plastic covers allowing to maintain a relative humidity ~~in the order~~ of 100 %, Then, they were
81 taken in the greenhouse.

82 The severity of the disease was estimated, seven days after every inoculation by the pathogen,
83 by using the scale of Barrault (1989) for *H. oryzae* and that of Notteghem *et al.* (1980) for
84 *P. oryzae*.

85 The infection coefficients were then calculated by multiplying the incidence by the severity.
86 Then, the reduction's percentage of the disease was deducted comparing to the controls. A
87 reduction has been considered as significant, if it was superior to 50 %.
88 Each treatment was performed with two repetitions of five pots..

89 **2. 3- Persistence's estimation of the rice plants protection by various fungicides.**
90 A plots of plants were treated, only once at the stage of 3 to 4 leaves, by the most effective
91 fungicides retained in the previous experience. For every fungicide, the minimum dose which
92 gave the maximum of inhibition was used.

93 24 hours after the treatment, one of the plots was inoculated with ~~sporale~~ suspensions at 10^5
94 spores / mL of the pathogens. The reduction's percentage of the disease was noted one week
95 later. At this time, the second plot was inoculated with the pathogens to see if the protective
96 effect of the tested fungicides persisted one week after treatment.

97 Every week, the same operation was repeated to see the effect of fungicides, after 15, 22 and
98 29 days. So, according to the obtained results, a program of treatment by each fungicide
99 along the vegetative stage of the rice cycle development could be considered.
100 Controls, inoculated only with pathogens, have the same age to those of treated with
101 fungicides. After every inoculation with the pathogens, all the plants were placed, during 48

hours under black plastic covers in the conditions of the laboratory. Then, they were placed in a greenhouse. In all these works, every treatment was the object of 15 repetitions.

Results

Effect of tested fungicides on the severity and the incidence of the blast
The examination of the table 1 showed that the percentage of the incidence reduction and the severity of the blast on the leaves of the rice plants and consequently its infection coefficient, by the various fungicides, depends on the quantity to which the latter was applied. Indeed, the disease inhibition in the presence of Carboxine + Thirame at 300 ppm was complete. In the same quantity, Tricyclazole and Pyrazophos inhibit considerably the blast. The inhibition's percentages were respectively in the order of 75 and 73.2 %. The inhibition was total from 750 ppm.

Mancozebe was very effective against *P. oryzae* at the doses of 300 and 750 ppm, with inhibition's percentages which were respectively 85 and 92.3 %. A dose of 1000 ppm of this fungicide was necessary to reach 100 % of disease's reduction. Thiabendazole, Benomyl and Methylthiophanate required to be brought at 1500 ppm to inhibit completely the pathogen. Thiabendazole and Benomyl inhibited, significantly, the disease at 1000 ppm, the percentages of inhibition were higher than 50 %. At this dose, the inhibition by Methylthiophanate was practically inexistent.

No damage was brought to the rice leaves after their treatment with fungicides at all the tested doses in comparison with the healthy control, With the exception of the Carboxine + Thirame combination, which was found to be toxic to the plant from 1000 ppm.

2. 2-Effect of fungicides tested on the severity and the incidence?? of the blight.

The noted results in the table 2 showed that *H. oryzae* was completely eliminated at a dose of 750 ppm in the combination Carboxine + Thirame while a dose of 300 ppm inhibited it with 90.4 %.

Tricyclazole could protect totally the rice plant against *H. oryzae* only if it was applied in 1500 ppm. The total inhibition of the blight was reached by applying Mancozebe and Thiabendazole with the same doses from which we obtain a total elimination of *P. oryzae*. These doses were respectively 1000 and 1500 ppm.

Pyrazophos which were very effective against *P. oryzae*, practically had no effect on *H. oryzae* even if it was applied at the highest dose (2000 ppm). Indeed, in this dose the inhibition's percentage of the disease was only 30 %. Benomyl and Methylthiophanate applied at 1500 ppm, inhibited *P. oryzae* in 100 %. These products were effective in the same degree, against *H. oryzae* when they were applied at 2000 ppm.

2. 3-Estimation of the protection's persistence of the rice plants by various fungicides

The results which appear in tables 3 and 4 show that the association (Carboxine + Thirame) protected completely plants against *P. oryzae* and *H. oryzae* during one week. In 15th day, this

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140 protection was reduced (64.8 % against *P. oryzae* and 59 % against *H. oryzae*). The next
141 week, the plants were not protected compared to control plants those showed that to have a
142 protection, plants had to be almost treated every week. After the application of Pyrazophos

143 against *P. oryzae*, the protection of plants in the 15th day, was the highest (in the order of 90.1
144 %). It seemed that to protect plants, this product had to be applied every 15 days.

145 Besides, Mancozebe could not protect plants against *P. oryzae* and *H. oryzae* more than one
146 week also for Thiabendazole, applied so well against *P. oryzae* that against *H. oryzae*. In the
147 15th day the protective effect of these products did not persist anymore. These products had to
148 be thus applied every week.

149 Concerning Tricyclazole and Tricyclazole + Mancozebe, applied to the rice plants aged to 3
150 weeks, they continued to supply an excellent protection in these plants respectively against
151 *P. oryzae* and *H. oryzae*, even 4 weeks after treatment. These fungicides could thus protect
152 the plants against these two pathogens until the emergence of panicles.

153 Discussion and conclusion

154 The results showed that *P. oryzae* was radically inhibited, on the leaves of rice plants, at a
155 dose of 300 ppm of the association Carboxine + Thirame, while *H. oryzae* was completely
156 inhibited only at the dose of 750 ppm of this product. However, this product provoked a total
157 yellowing of leaves. Thus, this product was not recommended, especially as it requires
158 repeated applications.

159 Besides, Pyrazophos has no effect on *H. oryzae* at very high doses. However, this product
160 inhibits totally *P. oryzae* at a dose of 750 ppm. To protect the leaves of rice plant against the
161 blast during all the vegetative phase, this product must be quite applied during two weeks.
162 On the other hand, Tricyclazole at 750 ppm inhibited totally the severity of *P. oryzae* on the
163 leaves of rice. While against *H. Oryzae*, a dose of 1500 ppm of the product was required to
164 reach the same level of protection. when this product was combined to Mancozebe, *H.*
165 *oryzae* was completely inhibited in 750 ppm.

166 Besides, Mancozebe inhibited radically both pathogens at the dose of 1000 ppm. However,
167 when Mancozebe had to be applied every week to protect the leaves of rice plants till the end
168 of the vegetative phase, a single application of Tricyclazole or combination Tricyclazole +
169 Mancozebe continued to protect the leaves of rice respectively against *P. oryzae* and *H.*
170 *oryzae* until the emergence of panicles.

171 A study, carried in field in height, by Mbodj *et al.*, (1987) showed that in Senegal,
172 Tricyclazole reduces the infection of the rice by *P. oryzae* in the same obtained degree by
173 using resistant varieties. These authors tested doses 300 and 600 g / ha, which showed an
174 inhibition considerable and better than at the dose of 150 g / ha. This product was also used to
175 differentiate the sensibility of the varieties in the leaves blast of the panicles.

176 Gouraminis (1996) also reported that this systemic fungicide is specifically very active
177 towards *P. oryzae*. Also, this fungicide showed itself the most effective *in vitro* and *in vivo*
178 against *Curvularia lunata* considered as a pathogen of rice plants; (Hassikou *et al.*, 2002).
179 Sowa *et al.* (2014), formulated a mixture of fungicides to control the most rice fungal

180 pathogens of which *P. oryzae* and *H. oryzae*. Among the components of this mixture there
 181 were Tricyclazole, Mancozebe and Pyrazophos. Mustafa *et al.* (2013) showed that
 182 Tricyclazole applied on leaves was effective on the yield. Kurahashi (2001) reported that
 183 Tricyclazole was an inhibitor of the melanin's synthesis in the appressoria of *P. oryzae*
 184 preventing the penetration in the rice also by inhibiting the polyhydroxynaphtaline reductase.

185 The efficiency of the mancozebe was indicated by several authors. Indeed, Dev (1980)
 186 reported that Mancozebe, inhibits *H. oryzae* but at a dose of 2 kg/ha. Besides, Percich (1989)
 187) and Johnson and Percich (1992) showed that this product, applied only, in 7 days apart
 188 either further to an application of Propiconazole protects the rice plants of the natural
 189 infection by *H. oryzae* and so increased the yield (38-120 %) in height fields. Besides, Kohls
 190 *et al.* (1987) maintained control pots not affected naturally by *H. oryzae*, along the vegetative
 191 cycle of the rice, by a treatment (processing) with 2,24 kg / ha of Mancozebe.

192 In the term of this study, a program of treatment (processing) by the most effective fungicides
 193 has to be established while taking into account their rice plants protection's duration during
 194 all the vegetative phase against the blast and the blight. This calendar was distributed as
 195 follows:

196 The foliar treatment of the sixth week is as follows:

- 197 - A single treatment by Tricyclazole in 750 ppm against *P. oryzae* or Tricyclazole +
 198 Mancozebe in 750 ppm towards *H. oryzae*;
- 199 - An application **everything??** 15 days by Pyrazophos in 750 ppm against *P. oryzae*;
- 200 - An application every week by Mancozebe in 1000 ppm against *P. oryzae* and *H. oryzae*.

201 Table-1 : Effect of the tested fungicides on reducing the severity and **incidence** of blast on
 202 rice leaves.

Fungicide	Dose (ppm)					
		300	750	1000	1500	2000
control	I	45	45	45	45	45
	S	7	7	7	7	7
	IC	3.5	3.5	3.5	3.5	3.5
Carboxine+Thirame	I	0	0	T	T	T
	S	0	0	T	T	T
	IC	0	0	T	T	T
	R (%)	100 a	100 a	T	T	T
Tricyclazole	I	31.5	0	0	0	0
	S	2.5	0	0	0	0
	IC	78.7	0	0	0	0
	R (%)	75 d	100 a	100 a	100 a	100 a
Pyrazophos	I	29.1	0	0	0	0
	S	2.9	0	0	0	0

	IC	84.4	0	0	0	0
	R (%)	73.2 d	100 a	100 a	100 a	100 a
Mancozebe	I	21,5	24,3	0	0	0
	S	2,2	1	0	0	0
	IC	47.3	24.3	0	0	0
	R (%)	85 c	92.3 b	100 a	100 a	100 a
Thiabendazole	I	44.1	42	33.4	0	0
	S	7	5.1	3.3	0	0
	IC	308.7	214.2	110.2	0	0
	R (%)	2 i	32 g	65 e	100 a	100 a
Benomyl	I	43.6	44	38.8	0	0
	S	7	5.1	3.3	0	0
	IC	305.2	299.2	151.3	0	0
	R (%)	3 hi	5 h	52 f	100 a	100 a
Methyl-thiophanate	I	44.3	44	44.6	0	0
	S	7	7	6.7	0	0
	IC	310.1	308	298.8	0	0
	R (%)	1.5 i	2.2 i	5.1 h	100 a	100 a

203

204 I: Incidence ; S: Severity; IC : Infection's Coefficient; R(%) : Reduction's Percentage, T :

205 Toxic Dose.??

206 Two results affected by the same letter did not differ significantly, at the 5% threshold
 207 (Newman and Keuls test).

208

209

210 **Table-2** : Effect of the tested fungicides on the reduction of the severity and incidence?? of
 211 helminthosporiasis on rice leaves.

Fungicide	Dose (ppm)					
		300	750	1000	1500	2000
Control	I	45	45	45	45	45
	S	7	7	7	7	7
	IC	315	315	315	315	315
Carboxine+ Pirime	I	29.8	0	T	T	T
	S	1.20	0	T	T	T
	IC	35.8	0	T	T	T
	R (%)	90.4 c	100 a	T	T	T
Tricyclazole	I	40.8	43.2	32.2	0	0
	S	6.5	5.1	2.9	0	0
	IC	265.2	220.3	93.4	0	0
	R (%)	29 i	41 h	75 e	100 a	100 a
Pyrazophos	I	44.9	44.3	44	42.1	40.2
	S	8.1	8	7.8	7.1	6.5
	IC	363.7	354.4	343.2	298.9	261.3
	R (%)	2.6 mn	5.1 l	8.1 k	20 j	30 i
Mancozebe	I	38.6	36.4	9.7	0	0
	S	4.7	2	0.5	0	0
	IC	181.4	72.8	4.85	0	0
	R (%)	51.4 g	80.5 d	98.7 b	100 a	100 a
Imabendazole	I	44.4	40.8	36.9	0	0
	S	8.3	6.2	4.1	0	0
	IC	368.5	253	151.3	0	0
	R (%)	1.3 n	32.3 i	59.6 f	100 a	100 a
Benomyl	I	45	44.4	40.9	31.1	0
	S	8.4	8.2	7.3	2.4	0
	IC	378	364.1	298.6	74.6	0
	R (%)	0 o	2.5 mn	20.1 j	80 d	100 a
Methyi-thiopnate	I	44.6	44.8	43.1	40.8	0
	S	8.1	7.9	7.8	6.4	0
	IC	361.3	353.9	336.2	261.1	0
	R (%)	3.3 lm	5.2 l	10 k	30 i	100 a
Tricyclazole + Mancozebe	I	26.1	0	0	0	0
	S	1.5	0	0	0	0
	CI	39.2	0	0	0	0
	R (%)	89.5 c	100 a	100 a	100 a	100 a

212 I: Incidence ; S : Severity ; IC : Infection's Coefficient; R(%) : Reduction's Percentage, T :
 213 Toxic Dose.

214 Two results affected by the same letter did not differ significantly, at the 5% threshold
 215 (Newman and Keuls test).

217

218 **Table -3** : Persistence of the fungicides effect on the reduction of blast, following a single treatment
219 of rice plants in the 3-4 leaves stage.

Fongicide	Dose (ppm)		8 days	15 days	22 days	29 days
Control	0	S	7.2	7.1	6.5	5
Carboxine+Thiram e	300	S	0	2.5	6.1	5.2
		R (%)	100 a	64.8 d	6.2 f	0 h
Tricyclazole	750	S	0	0	1,2	1
		R (%)	100 a	100 a	81.5 c	80 c
Pyrazophos	750	S	0	0.7	6.3	4.9
		R (%)	100 a	90.1 b	3.1 g	2 g
Mancozebe	1000	S	0	6.7	6.6	4.9
		R (%)	100 a	5.6 f	0 h	2 g
Thiabendazole	1500	S	0	5.8	6,4	5.2
		R (%)	100 a	18.3 e	1.5 g	0 h

220

221 Two results affected by the same letter did not differ significantly, at the 5% threshold
222 (Newman and Keuls test).

223 **Table -4** :Persistence of the fungicides effect on the reduction of blight, following a single treatment
224 of rice plants in the 3-4 leaves stage.

225

Fungicide	Dose (ppm)		8 days	15 days	22 days	29 days
Témoin	0	S	8	7.8	7.3	5.7
Carboxine+Thirame	300	S	0	3.2	7.2	5.5
		R (%)	100 a	59 d	1.4 h	3.5 g
Mancozèbe	750	S	0	6.2	7.2	5.5
		R (%)	100 a	20.5 e	1.4 h	3.5 g
Tricyclazole+Mancozèbe	1000	S	0	0	0.6	0.8
		R (%)	100 a	100 a	91.8 b	86 c
Thiabendazole	1500	S	1.5	3	7.1	5.8
		R (%)	100 a	15.4 f	0 i	0 i

226 S : Severity ; R(%): Réduction percentage.

227 Two results affected by the same letter did not differ significantly, at the 5% threshold
228 (Newman and Keuls test).

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Bibliographic References

- 231 **Anwar A., Bhat M. Shafi. 2005.** Efficacy of fungicides as seed treatment in the
232 management of blast disease of rice in nurserybed, Agricultural Science Digest. Vol 25, issue
233 4, p:293-295.
- 234 **Arunyanart P., Surin A., Disthaporn S. 1981.** Seed discoloration disease and its chemical
235 control. International Rice Research Newsletter, 6(3) : 14-15.
- 236 **Aulakh K.S., Mathur S.B., Neergaard P. 1974.** Seed health testing of rice and comparison
237 of field incidence with laboratory counts of *Drechslera oryzae*. Seed Sci. Technol., 2 : 393-
238 398.
- 239 **Barraut G. 1989.** L'helminthosporiose de l'orge causée par *Drechslera teres*. Thèse de
240 Doctorat d'Etat. Institut National Polytechnique de Toulouse, France.
- 241 **Canonica L. Fiechi A. Galli Kienle M. Ranzi B.M., Scala A. 1966a.** The biosynthesis of
242 cochliobolins A and B. Tetrahedron Lett., 26 : 3035-3039.
- 243 **Canonica L. Fiechi A. Galli Kienle M. Ranzi B.M., Scala A. 1966b.** The constitution of
244 cochliobolin. Tetrahedron Lett., 11 : 1211-1218.
- 245 **Chastain T.G., Klepper B.L., Wilkins D.E. 1994.** Relationship of wheat seed sprouting
246 severity, planting depth and seed treatment to emergence and yield Crop Science (USA).
247 (Mar-Apr 1994), 34 (2) : 508-513.
- 248 **Chhetry G.K.N. 1993.** Effect of some fungicides on the brown leaf spot in five paddy
249 varieties. Annals of Plant Protection Sciences, 1: 135-136.
- 250 **Cocucci S.M., Morgutti S., Cocucci M., Gianani L. 1983.** Effects of ophiobolin A on
251 potassium permeability, transmembrane electrical potential and proton extrusion in maize
252 roots. Plant Sci. Lett., 32 : 9-16.
- 253 **Dev V.P.S. 1980.** Chemical control of helminthosporiose of rice. International Rice Research
254 Newsletter 5 (4) : 17-18.
- 255 **Evidente A., Andolfi A., Cimmino A., Vurro M., Fracchiolla M., Charudahan R. 2006.**
256 Herbicidal potential of ophiobolins produced by *Drechslera gigantea*. J. Agric. Food Chem.,
257 54 (5) : 1779-1783.
- 258 **Ezzahiri B., Ghachtouli F. 1996.** Efficacité de quelques fongicides de traitement des
259 semences contre les maladies foliaires du blé et de l'orge. Bull. Transfert de technol. N° 19
260 Avril : 2-4.
- 261 **Froyd J.D., Paget C.J., Guse L.R., Dreikon B.A., Pafford J. I. 1976.** Tricyclazole, a new
262 systemic fungicide for control of *Pyricularia oryzae* on rice. Phytopathology, 66 : 1135-1139.

- 263 **Geetha D., Sivaprakasam K. 1993.** Treating rice seeds with fungicides and antagonists to
264 control seedborne diseases. International rice research notes (philippines), 18 : 30-31.
- 265
- 266 **Ghazanfar M.U.W., Wakil S.T. Sahi, Saleem U.L. Yasin. 2009.** Influence of various
267 fungicides on the management of rice blast disease. Mycopath. 7 : 29-34.
- 268 **Gouraminis G.D. 1996.** The present status of rice diseases and their control on northern
269 Greece. Cahiers Options Méditerranéennes, 15: 97-100.
- 270 **Guerber C., Te Beest D.O. 2006.** Infection of rice seed grown in arkansas by *Pyricularia*
271 *grisea* and transmission to seedlings in the field. Plant disease, 90 (2) : 170-176.
- 272 **Hassikou R., Hassikou K., Ouazzani Touhami A., Douira A. 2002.** Effect in vitro et in
273 vivo de quelques fongicides sur *Curvularia lunata*. Revue marocaine des sciences
274 agronomiques et vétérinaires vol 22, N°4.
- 275 **Honda Y., Nemoto M. 1985.** Control of seedling blast of rice with ultraviolet-absorbing
276 vinyl film. Plant Dis., 69 : 596-598.
- 277 **ITCF, 1990.** Le traitement des semences pour un grain de beauté. Phytoma, 420 : 16-17.
- 278 **Ito S. 1932.** Primary out break of the important diseases of the rice plant and common
279 treatment for their control. Hokkaido Agric. Exp. Str. Rep. 28 : 211 in Japanese with English
280 summary).
- 281 **Johnson D.R., Percich J.A. 1992.** Wild rice domestication, fungal brown spot disease, and
282 the future of commercial production in Minnesota. Plant Dis., 1193-1198.
- 283 **Kaisair W. J., Hannan R. M. 1988.** Seed transmission of *Ascochyta rabiei* in chickpea and
284 its control by seed-treatment fungicides. Seed Sci. And Technol., 16 : 625-637.
- 285 **Kumbhar C.T. 2005.** Evaluation of new fungicidal formulations against blast disease of rice
286 . Karnataka. J. Agric. Sci., 18 : 184.
- 287 **Kurahashi Y. 2001.** Melanin biosynthesis inhibitors (MBIs) for control of Rice Blast.
288 Pesticide outlook-February 2001. DOI. 10 1039/b1008060.
- 289 **Lee P.N. 1994.** Rice breeding programs, blast epidemics and blast management in the United
290 states. Pages 489-500 in : Rice Blast Disease. R.S. Zeigler, S.A. Leong and P.S. Teng, eds.
291 CAB Int, Wallingford, Oxon, U.K. and Int. Rice Res. Inst, The philippines.
- 292 **Loegering W.D. 1959.** Method for recording cereals rust data. Washington, International
293 Spring Wheat Rust Nursey, 1959, USDA.
- 294 **Long D.H., Corell J.C., Lee F.N., Te Beest D.O. 2001.** Rice Blast epidemics initiated by
295 infested rice grain on the soil surface. Plant disease, 85 (6) : 612-616.

- 296 **Manandhar H.K. 1996.** Rice blast disease : seed transmissio n and induced resistance.
297 P.H.D thesis. The royal veterinary and agricultural University. Copenhagen, Denmark.
- 298 **Manandhar H.K., Jorgensen H.J.L., Smedegaard-Peterson V., Mathar S.B. 1998a.**
299 Seedborne infection of rice by *Pyricularia oryzae* and its transmission to seedlings. Plant
300 Dis., 82 : 1093-1099.
- 301 **Manandhar H.K., Jorgensen H.J.L., Smedegaard-Peterson V., Mathar S.B. 1998b.**
302 Suppression of rice blast by preinoculation with avirulent *Pyricularia oryzae* and the non rice
303 pathogen *Bipolaris sorokiniana*. Phytopathology, 88 : 735-739.
- 304 **Mbodj Y., Gaye S., Diaw S. 1987.** The role of Tricyclazole in rice protection against blast
305 and cultivar improvement. Parasitica, 43 (4) : 187-198.
- 306 **Meah M.B., Islam M.R., Islam M.M. 2004.** Developpement of an integrated approch for the
307 management of phomopsis blight and fruit rot of eggplant in Bangladesh, Annual Research
308 Report, Dept of plantpathology. BAU, Mymensingh, Bangladesh, 57p.
- 309 **Mustafa A., Yassin S.I., Mahmood S., HAnnan A., Akhtar M. 2013.** Field evaluation of
310 new fungicides against rice (*Oryza sativa*) diseases. Pakistan Journal of Phytopathology. Vol
311 25, n°2 : 141-145.
- 312 **Nghiep H. V., Gaur A. 2004.** Role of *Bipolaris oryzae* in producing abnormal seedling of
313 rice (*Oryza sativa*). Amonrice 12, 102-108.
- 314 **Nishimura S., Nakatsuka S. 1989.** Trends in host-specific toxin research in Japan. Pages
315 19-31 in : Host –specific Toxins : Reconition and Specificity Factors in Plant Diseases. K.
316 Kohnoto and R.D. Durkin, eds. Tottori University, Japan.
- 317 **Notteghem J.L., Anriatampo G.M., Chatel M., Dechanet R. 1980.** Technique utilisée pour
318 la selection de variété de riz possédant la résistance horizontale à la pyriculariose. Ann.
319 Phytopathol., 12: 199-226.
- 320 **Nyvall R.F., Percich J.A. Porter R.A. et Brontner J.A. 1995.** Comparison of fungal Brown
321 spot severity to incidence of seedborne *Bipolaris oryzae* and *Bipolaris sorokiniana* and
322 infected floral sites on cultivated wild rice. Plant Dis., 79 : 249-250.
- 323 **Orsenigo M. 1956.** Produzione di tossine da parte de *Helminthosporium oryzae* Breda de
324 HAan. Parte I. ANN. Sper. Agric. N. S. 10 : 1745-1762.
- 325 **Orsenigo M., Paran. D. 1958.** Isolamento proprieta e modalita diazione della cochliobolina.
326 Una tossina prodotta de *Helminthosporium oryzae* Breda de Haan. Ann. Fac. Agric. S.
327 Curora, Ser., 6 (1) : 19-54.
- 328 **Ou S.H. 1985.** Rice diseases. Common Wheath Microbiological Institue. Kew, surrey,
329 England. 380p.

- 330 **Percich J.A. 1989.** Comparison of propiconazole rates for control of fungal brown spot of
331 wild rice. Plant Dis., 73 : 588-589.
- 332 **Riazuddin M., Rahman H., Haque A.H.M., Islam M.S., Kamal M.M. 2009.** Efficacy of
333 botanicals for controlling seed borne fungal pathogens and seed germination of rice.
334 Ecofriendly Agricultural Journal, 2 (9) :814-817.
- 335 **Sowa C., Dohmen G.P., Obermann M. Riediger N., Klappach K., Schmit M., Stierl R.**
336 **2014.** Formulation for paddy rice fields N° de la publication : US 20140193772A1.
- 337 **Tipton C.L., Paulsen P.V., Betts R.E. 1977.** Effects of ophiobolin A on ion leakage and
338 hexose uptake by maize roots. Plant Physiol., 59: 907-910.
- 339 **Variar M., maiti D., Shukla V.D. 1993.** Efficacy of combination of fungicide formulation
340 on management of rice blast (*Pyricularia oryzae*) in rainfed upland. Indian J. of Agricultural
341 Sci., 63 (6): 386-389.
- 342 **Vidhyasekaran P., Borromeo E.S., Mew T.W. 1986.** Host-specific toxin production by
343 *Helminthosporium oryzae*. Phytopathology, 76 : 261-266.
- 344 **Xiao J.Z., Tsuda M., Doke N., Nishimuras. 1991.** Phytotoxins produced by Germinating
345 spores of *Bipolaris oryzae*. Phytopathology, 81: 58-64.
- 346 **Yeasmin F., Ashrafozszaman M., Hossain I. 2012.** Effects of Garlic extract, Allamanda
347 leaf extract and Provax-200 on seed borne fungi of rice. The agriculturalturists, vol 10, n° 1 :
348 46-50.
- 349 **Zad S.J. , Khosravi V. 2000.** Investigation on important diseases of dominant rice cultivars
350 in Mazandaran (Iran). 52nd International Symposium on Crop Protection, p : 9. Gent Belgium.