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Research Article

EFFECTIVENESS OF SOME FUNGICIDES APPLIED TO RICE SEED ON BLAST AND LEAF BLIGHT

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ABSTRACT

This article proposes a study of the effect of various doses of fungicides in presence and in absence of *Pyricularia oryzae* or of *Helminthosporium oryzae*, on the germination of seeds, on the length of coleoptiles, roots, the lesions on coléoptiles and on duration of protection of the plants of rice, against both pathogens.

Accordingly, the fungicides protection of seeds against appearances inferred by both pathogens depends on the pathogen, and the dose of the fungicide used. Besides, among tested fungicides, only tricyclazole, mancozebe and the carboxine +Thiram association are able to provoke an increase of the germination of seeds, length of coleoptiles and roots as well as a decrease of the lesions on coleoptiles for both pathogens without damaging seeds.

Indeed, Tricyclazole and Carboxine + Thirame association, brought respectively to 1 g / kg and 1 ml / kg of grains, reduces to 100%(fully) the development of the necrosed hurts caused on the coleoptile by *P. oryzae*. Mancozébe at 2 g / kg of grains got 87 % of reduction of the disease. However, a better germination of grains and a good development of the coleoptile and the roots require 2 g / kg of Tricyclazole, 3 g / kg of Mancozebe and 3 ml / kg of the combination Carboxine + Thirame. Mancozebe at 3 g / kg protects better the coleoptile against the lesions caused by *H. oryzae* (94.4 %), followed by Tricyclazole at 3 g / kg (80.5 %) and Carboxine + Thirame at 3 ml / kg (72.2 %). These doses also increase the percentage of germination of grains, the length of roots and coleoptiles.

The treatment of grains using 1 and 2 grammes of Tricyclazole per kilogramme of grains strongly protected the seedlings of rice for four weeks, compared to the treatment based on *P. oryzae* (respectively 81.3 and 89.33 % at 4th week). This fungicide, brought to 3 g / kg of grains, continues to protect plants even five weeks after the treatment (77.78 %).

Concerning the helminthosporiose, Tricyclazole applied to 3 g / kg of grains reduced the disease to 77.8 % and 70.7 % respectively three and four weeks after treatment.

When the tricyclazole is mixed with Mancozebe (1.5g+1.5g) the reduction reaches 100% during the 6th week for *P. oryzae* and 84.29% for *H. oryzae*.

INTRODUCTION

The seeds constitute the preferred means by which the plants'disease-causing agents are introduced into new production zones. They survive in periods when the host plant is absent and propagate from the hearth's infection in the vegetable populations.

The seeds carrying the parasites do not show any visible symptom; it is often necessary to analyse or to examine the seedlings after planting to prove their presence.

These difficulties result from an insufficiency of studies conducted in the field of the pathology of the seeds and of the different means of protection. This is particularly alarming when it is known that the seeds are at the origin of the majority of the crop productions. That it is important to know the risks incurred by transporting a parasite from a place to another, its conservation from one season to another or its transmission to the following generations.

P. oryzae and *H. oryzae* remain the two principal fungic agents, which significantly reduce the weight of the rice seeds and cause a reduction of germination (Meah *et al*., 2004; Riazuddin *and al*., 2009 and Yeasmin *et al*., 2012). The presence of these organisms on or in the seeds does not inevitably result in a lack of lifting, but in the formation of abnormal seedlings.until their maturity and a reduction of the strength of the seedlings by a

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deceleration of the growth of the roots and coléoptiles (Manandhar *et al*., 1998 a and b; Zad and Khosravi, 2000; Nghiep and Gaur, 2004; Guerber and Tebeest, 2006).

The phytoprotection is the first determining intervention in the crop protection; it protects not only the seeds but also the roots and the air parts of the seedlings during the first stages of their development (ITCF, 1990; Kumbhar, 2005; Ghazanfar *et al*., 2009). The purpose of this study is to test the effect of rice grains treatment, by different amounts of fungicides, in absence or in presence of *P. oryzae* or *H. oryzae*, on: 1/ the germination of grains; 2/ the length of the coleoptiles, of the roots and of the lesions over the coleoptiles; 3/ the duration of protection of the rice plants, against the pyriculariose and the helminthosporiose.

MATERIALS AND METHODS

Pathogens

Isolates FK1 of *Pyricularia oryzae* and Hot of *Helminthosporium oryzae*, respectively isolated from the foliar lesions of Kenz and Triomphe varieties rice, are cultivated on medium containing rice flour (14g of flour of rice, 4g of yeast extract, agar-agar 15g, distilled water 1000 ml) during 15 days at 28°C and in the darkness for *P. oryzae* (Benkirane *et al*., 1994) and under continuous light for *H. oryzae* (Bouslim *et al*., 1997). When the cultures cover the boxes, surface charged with spores is scraped using a metal spatula. The mycelium is put in suspension in sterile distilled water, and then filtered through a fabric in muslin. The concentration of the sporal suspention obtained is adjusted, with distilled water containing 0.02% of Tween 20 and gelatine 0.5% at 10^5 spores/ml.

Treatment of the grains of rice

The grains of the variety Triomphe of rice are divided into batches. Each batch is treated by Tricyclazole, Thiabendazole, Bénomyl, Methyl-thiophanate or Mancozèbe each one at 0, 1, 2, and 3 g/kg of grains. Carboxine + Thirame association is brought to amounts 0, 1, 2, and 3 ml/kg of grains.

The grains are soaked in 100 ml of the suspension of each fungicide and are maintained in agitation during 30 mn. The grains are then dried on filter paper during 24 hours. At the end of the which, each batch is divided into two boozers:

The first boozer of grains is inoculated with sporalsuspensions of *P. oryzae* and *H oryzae* at $l0^5$ spores/ml each one. The grains are then put to dry on filter paper.

The control grains are treated either by one of fungicides, or only by the pathogen, or by sterile distilled water. All the grains, inoculated and not inoculated, are then deposited in boxes of Petri containing the cotton soaked with sterile distilled water. These last are put in incubation at the darkness and 28°C during three days then under continuous light during 5 days. At the end of this time, the percentage of germination of the grains is calculated compared to the control. The length of the roots, the coléoptiles and the developed necrotic lesions are measured on the germinated grains. From these lesions, we deducted the percentage of inhibition to the disease.

The other boozer of grains was put to germe in boxes of Petri containing cotton soaked with distilled water and incubated during 75 hours in the darkness at 28°C. Then, these germed grains are planted in pots and are watered. These pots are divided into batches. Two weeks after plantation; one of these batches is inoculated by spirals suspensions of the two pathogens to observe the persistence of protective effect of fungicides. The same operation is realized, each week, on one of the batches.

The severity of the disease is estimated, seven days after each inoculation with the pathogenic, by using scale of Barrault (1989) for *H. oryzae* and that of Notteghem *et al*. (1980) for *P. oryzae*. The coefficients of infection are then calculated by multiplying the incidence by severity. Then, the percentage of reduction of the disease is deducted compared to the control. A reduction is regarded as significant, if it is higher than 50%.

Table 1 Effect of the preventive treatment of grains by fungicides 24 hours before the inoculation by the pathogen on some premature apparences of the pyriculariose: germination of grains, length of coléoptiles, length of roots and length of the hurts.

Treatement	Amount per kg of Grains	Percentage of germination of the grains	Average length of the coléoptile (mm)	Average length of the roots (mm)	Average length of lesions on coleoptile (mm)	Pourcentage of inihibition (%)
Inoculated control	0 g	46.6 j	15h	20 h	10 a	_
Healthy control	0 g	83.3 a	35 a	45 a	0 f	_
Tricyclazole + Fk1	1g	66,7^e	25d	45a	0f	100a
	2 g	80 b	33 ab	45 a	0 f	100a
	3g	83.3a	32 b	46 a	0 f	100a
Mancozèbe + FK1	1 g	60 g	20 e	44 ab	2.5 e	75 C
	2 g	70 d	25 d	45 a	1.1 f	87 b
	3 g	83.3 a	30 c	46 a	1 f	89 b
Bénomyl + FK1	1 g	66.7 e	25 d	29 f	8bc	20 g
	2 g	53.3 i	21 be	32 f	4.5 d	55 d
	3 g	46.7 j	17 fgh	27 g	4.5 d	55 d
Méthyl-Thiophanate +FK1	1 g	60 g	16 gh	31 e	10 a	0 i
	2 g	63.3 f	19 ef	37 d	9 ab	10 h
	3 g	63.3 f	20 e	40 c	8.2 bc	18 g
Thiabendazole + FK1	1 g	60 g	20 e	38 d	7.6 c	24 f
	2 g	53.3 i	18 efg	36 d	5.5 d	45 e
	3 g	53.3 i	15 h	32 e	5 d	50 d
Carboxine +Thirame + FK1	1 ml	56.7 h	18 efg	42 d	0 f	100 a
	2 ml	63.3 f	26 d	43 ab	0 f	100 a
	3 ml	73.3 c	27 d	45 a	0 f	100 a

Two results read on the same column affected of the same letter different step significantly, with the threshold of 5% (test of Newman and Keuls).

FK1: isolate of *P. oryzae*.

The control plants, inoculated only by the pathogens, have the same age as those treated. All plants are placed, after each inoculation by the pathogen, during 48 hours, under black plastic covers under the conditions of the laboratory. Then, they are placed under greenhouse. In all this work, each treatment is repeated 15 times.

RESULTS

Effect of the chemical treatment of the grains on the appearence provoked bypyriculariose and helminthosporiose

It arises from Tables 1 and 2 that *P. oryzae* and *H oryzae*, inoculated to grains, induced a reduction of the percentage of germination compared to the healthy control, a reduction length of the roots and that of the coléoptiles. These demonstrations are much more marked when the grains are inoculated by *P. oryzae* than in the case of those inoculated with *H. oryzae*. On the coléoptiles, the two pathogens cause necrotic lesions which are longer on grains inoculated with *H. oryzae*.

The protection of the grains, by fungicides, against the manifestations induced by the two pathogenics depends on the nature of pathogen, the fungicide used and the amount with which it was applied. Indeed, Table 1 reports that Tricyclazole and Carboxine+Thirame association, brought respectively at 1 g/kg and 1 ml/kg of grains, reduce to 100% the development of the necrotic lesions caused on the coléoptile by *P. oryzae*. Mancozebe with 2 g/kg of grains got 87% of reduction of the disease. However, a better germination of the grains (expressed by the number of germed grains), and a good development of the coléoptile and roots require an amount of 2 g/kg of Tricyclazole, 3 g/kg of Mancozèbe and 3 ml/kg of the Carboxine + Thirame combination. The Table 2 shows that Mancozèbe with 3 g/kg protects best the coléoptile against the lesions caused by *H. oryzae* (94.4%), followed by Tricyclazole with 3 g/kg (80.5%) and Carboxine + Thirame with 3 ml/kg (72.2%). These amounts also increase the percentage of germination of the grains, the length of the roots and that of the coleoptiles.

Benomyl, and Thiabendazole, brought to 1 g/kg of grains, does not protect significantly the coléoptiles against the necrotic lesions. However, they inhibit, slightly but significantly, the lesions on coléoptiles with 2 and 3 g/kg of grains. The percentages of inhibition are respectively of 55 and 50% for *P. oryzae* and of 61.1 and 56.7% for *H. oryzae*. However, these amounts are toxic for the grains. This is seen clearly in the results of Table 3 where is represented the effect of the various amounts of the fungicides, applied only to the grains. Indeed, more the amount of fungicides is raised; more they inhibit the germination of the grains, the length of the coléoptiles and that of the roots. For Methyl-Thiophanate, even when it is brought to the greatest amount tested (3 g/kg of seeds), it does not damage the grains. But, this amount cannot reduce, significantly, the lesions on coléoptile, caused the two pathogens (Table 3).

For the following experiment, we retained only fungicides which showed an increase in the germination of the grains, length of the coleoptiles and roots as well as a reduction of the lesions on the coleoptiles. Those fungicides are: the Tricyclazole, the Carboxine+Thirame combination and Mancozèbe. Moreover, the results consigned in Table 3 clearly show that in comparison with the healthy witness, Tricyclazole do not damage the grains, even when it is brought to 3 g/kg of grains. Carboxine + Thirame and Mancozèbe, respectively to 2 and 3 g/kg of grains, stimulate even the germination of the grains, the length of the roots and that of the coleoptiles.

Duration of protection of the rice sheets against the blast and leaf blight, following the treatments of the grains by various fungicides

The results of Tables 4 and 5 indicate that the treatment of the grains of rice with Mancozèbe, which is a fungicide of contact, could not protect the seedlings at the two weeks age against the attacks caused by *P. oryzae* and *H. oryzae*. However, used with the amount of 3 g/kg, a light reduction of the two diseases is noted compared to the control.

Tableau 2 Effect of the preventive treatment of grains by fungicides 24 hours before the inoculation by the pathogen on some premature apparences of the helminthosporiose: germination of grains, length of coléoptiles, length of roots and length of the hurts.

Treatement	Amount per kg of Grains	Percentage of germination of the grains	Average length of the coléoptile (mm)	Average length of the roots (mm)	Average length of lesions on coleoptile (mm)	Pourcentage of inihibition (%)
Inoculated control	0 g	66.7 d	25 gh	30 e	18 a	_
Healthy control	0 g	83.3 b	35 bc	45 a	0 i	_
	1g	80 b	33 c	40 b	6.8 f	66.6 e
Tricyclazole + Hot	2 g	86.7 a	35 bc	45 a	6 fg	66.6 e
	3g	80 b	38 a	45 a	3.5 h	80.5 b
	1 g	70 d	29 def	42 b	5 gh	72.2 d
Mancozèbe + Hot	2 g	73.3 c	30 de	41 b	4 h	77.7 c
	3 g	83.3 b	34 bc	46 a	1 i	94.4 a
	1 g	66.7 d	27 fg	35 cd	10 d	44.4 i
Bénomyl + Hot	2 g	50 f	22 i	30 e	7 f	61.1 f
	3 g	36.7 g	19 j	24 f	7 f	61.1 f
	1 g	73.3 c	28 ef	33 d	18 a	0 i
Méthyl-Thiophanate + Hot	2 g	80 b	31 d	36 c	15 b	16.7 k
	3 g	83.3 b	35 bc	41 b	13 c	27.8 j
	1 g	60 e	23 hi	25 f	9 de	50 h
Thiabendazole + Hot	2 g	50 f	19 j	22 g	8 ef	55.6 g
	3 g	33.3 h	15 k	18 h	7.8 ef	56,7 g
Carboxine +Thirame	1 ml	66.7 d	24 hi	28 e	8 ef	55.6 g
+	2 ml	73.3 c	29 def	35 cd	6,4 fg	64.4 e
Hot	3 ml	80 b	36 b	44 a	5 gh	72.2 d

Two results read on the same column affected of the same letter different step significantly, with the threshold of 5% (test of Newman and Keuls).
Hot: isolate of *H. oryzae.*

Table 3 Effect of the fungicides applied to the grains, only and with various amounts to germination, the length of the coléoptiles and that of the roots.

Treatment	Amount per kg of Grains	Percentage of germination of the grains	Averagelength of the coléoptile (mm)	Averagelength of the roots (mm)
Healthycontrol	0 g	83.3 d	35 ef	45 ef
Tricyclazole	1g	90 b	40 c	48 de
	2 g	100 a	40 c	50 cd
	3g	86,7 c	35 ef	44 f
Mancozèbe	1 g	100 a	40 c	50 cd
	2 g	100 a	40 c	52 bc
	3 g	100 a	45 a	55 a
Bénomyl	1 g	76.6 e	33 f	44 f
	2 g	66.7 g	27 h	36 gh
	3 g	56.7 h	22 j	25 j
Méthyl-Thiophanate	1 g	83.3 d	36 de	43 f
	2 g	80 d	35 ef	44 f
	3 g	73 f	35 ef	45 ef
Thiabendazole	1 g	60 h	31 g	38 g
	2 g	60 h	25 i	35 h
	3 g	50 i	22 j	31 i
Carboxine +thirame	1 ml	86.7 c	37 de	46 ef
	2 ml	100 a	38 cd	50 cd
	3 ml	100 a	43 b	54 ab

Two results read on the same column affected of the same letter different step significantly, with the threshold of 5% (test of Newman and Keuls).

Table 4 Duration of protection of the rice plants, against the pyriculariose, following the treatments of the grains by various fungicides

Treatment	Amount per kg of Grains		3rd week	4rd week	5rd week	6rd week
control	0 g	S	8.90	7.50	7.20	6.30
Tricyclazole	1g	S	0.60	1.60	5.10	6.10
		R (%)	93.26 b	81.3 d	29.17 kl	3.17 t
	2 g	S	0,00	0,80	4,20	4,50
		R (%)	100 a	89.33 c	41.67 g	28.57 kl
	3g	S	0.00	0.00	1.60	3.80
		R (%)	100 a	100 a	77.78 e	39.68 gh
Mancozèbe	1 g	S	8.90	7.30	7.20	6.30
		R (%)	0 v	2.67 t	0 v	0 v
	2 g	S	8.10	6.90	6.50	6
		R (%)	8.99 q	8 qr	9.72 q	4.76 s
	3 g	S	6.50	5.80	5.50	4.20
		R (%)	26.97 lm	22.67 n	23.61 mn	33.33 jk
Carboxine +Thirame	1 ml	S	6.50	7.40	7.20	6.20
		R (%)	26.97 lm	1.33 u	0 v	1.59 u
	2 ml	S	5.70	7	7	6.20
		R (%)	35.96 hij	6.67 rs	2.78 t	1.59 u
	3 ml	S	5.50	6.50	6	5.20
		R (%)	38.20 ghi	13.33 p	16.67 o	17.46 o
Tricyclazole + Mancozèbe	0,5 + 0,5 g	S	0.00	1.30	3.50	4.10
		R (%)	100 a	82.67 d	51.39 f	34.92 ij
	1 g + 1 g	S	0.00	0.00	0.00	1.30
		R (%)	100 a	100 a	100 a	79.37 e
	1,5 g + 1,5 g	S	0.00	0.00	0.00	0.00
		R (%)	100 a	100 a	100 a	100 a

S: Severity; R (%): Percentage of reduction.
Two results read on the same column affected of the same letter different step significantly, with the threshold of 5% (test of Newman and Keuls).

This can be explained by the fact that this amount, stimulating the growth of the roots and that of the coléoptiles and the germination of the grains, gave to the plants a great strength compared to the control plants. A light inhibition is also noted in the case of the Carboxine + Thirame combination, when it is brought to 3 g/kg of grains. Treatment of the grains with Tricyclazole at the amounts of 1 and 2 g/kg of grains strongly protected the seedlings from rice, during four weeks, against *P. oryzae* (respectively 81.3 and 89.33% at the 4th week). This fungicide brought to 3 g/kg of grains, continuous to protect the plants even five weeks after the treatment (77.78%).

Concerning the leaf blight, Tricyclazole applied at 3 g/kg of grains reduced the disease of 77.8% and 70.7% respectively three and four weeks after treatment. This inhibition is not significant any more five weeks after treatment of the grains.

The action of Tricyclazole mixed with Mancozebe is additive, this is reflected clearly on the percentages of reduction of the two diseases which increase and on the duration of persistence of its effectiveness which is prolonged compared to the effect of fungicides used separately. When two fungicides are brought to 1.5g each one (1.5 g + 1.5 g) the reduction reaches 100% at the 6th week for *P. oryzae* and 84.29% for *H. oryzae*.

Table -5 Duration of protection of the rice plants, against the helminthosporiose, following the treatments of the grains by various fungicides.

Treatement	Amount per kg of Grains		3rd week	4rd week	5rd week	6rd week
control	0 g	S	9	8,2	8,1	7
Tricyclazole	1g	S	9	8	8.10	6.90
		R (%)	0 r	2.44 q	0 r	1.43 q
	2 g	S	4	4,30	5,50	7
		R (%)	55.56 f	47.56 g	32.10 i	0 r
	3g	S	2.00	2.40	4.70	5.30
		R (%)	77.78 c	70.73 d	41.98 h	24.29 q
Mancozèbe	1 g	S	8.80	8.20	7.90	7
		R (%)	2.22 q	0 r	2.47 q	0 r
	2 g	S	8.50	8.20	8	6.80
		R (%)	5.56 p	0 r	1.23 q	2.86 q
	3 g	S	7.40	6.9	7.2	5.70
		R (%)	17.78 lmn	15.85 mn	11.11 o	18.57 lmn
Carboxine +Thirame	1 ml	S	7	8,20	8	7
		R (%)	22.22 kl	0 r	1.23 q	0 r
	2 ml	S	6,50	7,60	7,40	7
		R (%)	27.78 j	7.32 p	8.64 op	0 r
	3 ml	S	6	7	6.80	5.90
		R (%)	33.33 i	14.63 n	16.05 mn	15.71 mn
Tricyclazole + Mancozèbe	0,5 + 0,5 g	S	1.10	3	4.90	5.60
		R (%)	87.78 b	63.41 e	39.51 h	20 klm
	1 g + 1 g	S	0	0	1	2.40
		R (%)	100 a	100 a	87.65 b	65.71 de
	1,5 g + 1,5 g	S	0	0	0	1.10
		R (%)	100 a	100 a	100 a	84.29 b

S: Severity; R (%): Percentage of reduction.
Two results read on the same column affected of the same letter different step significantly, with the threshold of 5% (test of Newman and Keuls).

DISCUSSION AND CONCLUSION

P. oryzae and *H. oryzae* can attack any air part of rice including the grains, in which the hyphas and the conidies are preserved during several years, are transmitted to the following generations and of a place to another (Ito, 1932; Manandhar, 1996). *P. oryzae* occurs of the grains (Nyvall *et al.* 1995; Long *et al.*, 2001). The fungus is located in the external parts of the grains and rarely inside. Some works suggested the systemic transmission of *P. oryzae* from grains to the seedlings (Manandhar, 1996; Guerber and TeBeest, 2006).

In the tropical areas, where aerial inoculum is present along the year, the conservation of these fungi is not important in the cycle of the disease (ou, 1985). However, in the other areas, where the conservation is necessary for fungi, the infected grains play a significant role in the development of the pyriculariose and the helminthosporiose and constitute a primary source of inoculum (Honda and Nemoto, 1985; Lee, 1994; Manandhar, 1996).

The obtained results showed that *P. oryzae* and *H. oryzae* applied to the grains of rice, in the form of sporale suspensions (10^5 spores/ml), lead a reduction of germination, length of the roots and that of the coléoptiles. Indeed, other work announced that *H. oryzae* and *H. gigantea* produce a phytotoxine called ophioboline (Evidente *et al.*, 2006), which was also named cochlioboline (Orsenigo, 1957) or ophioboline A (Tipton *et al.*, 1977) or cochlioboline A (Canonica *et al.*, 1966 a and b). This phytotoxine was detected in the filtrate of culture and the fluid of the spores germinated respectively by Nishimura and Nakatsuka (1989) and by Xiao *et al.* (1991). The ophioboline reduces the germinative power of the grains, product anomalies on the seedlings hosts and not hosts of pathogenic (Orsenigo, 1956), inhibits the growth of the roots and of the coleoptiles (Orsenigo, 1957), stops respiration (Orsenigo and Paran, 1958) and affects the permeability of the cellular membranes (Cocucci *et al.*, 1983). *H. oryzae* produces also specific toxins of the host plant, which determine helminthosporiose on rice, and involve a discolouration of the grains (Arunyanart *et al.*, 1981; Vidhyasekaran *et al.*, 1986).

Moreover, this work revealed that these two pathogenic produces lesions necrotic on the coléoptiles of the seedlings resulting from the prégermed grains. Indeed, the embryonic end of the grains of rice, wich is rich in proteins, represents a preferred site for *P. oryzae* in nature, since the fungus reaches easily and quickly the coléoptile (Manandhar *et al.*, 1998b).

In addition, the treatment of the grains of rice by various fungicides tested, showed a great variability in the degree of reduction of the manifestations caused by *P. oryzae* and *H. oryzae*. Fungicides which showed a reduction of all the manifestations, due to the two pathogens, without presenting phytotoxicity to the grains are Tricyclazole, Mancozèbe and the Carboxine combination + Thirame. This last association and Mancozèbe, applied only to the grains, stimulate even their germination and increase the length of the coléoptiles and that of the roots.

The obtained results thus showed that the Carboxine + Thirame combination strongly inhibits the lesions on the coléoptiles of the two pathogens to an amount of 1 ml/kg of grains. However, the effectiveness of this product when it is applied to 3 ml/kg of grains, it is not maintained more than two weeks after treatment of the grains. In the same way, an amount of 1 g /kg of Tricyclazole is sufficient to reduce to 100% the necrotic lesions caused by *P. oryzae* on the coleoptile. However, with this same amount, the helminthosporiose is reduced only to 66%. To obtain 80% of reduction of the disease, the product must be applied to 3 g/kg of grains. Moreover, the maintenance of the

effectiveness of product 4 and 5 weeks respectively against *P. oryzae* and *H. oryzae* are noted only if the product is applied to an amount of 3 g/kg of grains.

In addition, the application of the mancozebe to 3 g/kg of grains effectively reduced the severity of the two diseases on the coléoptiles. Whereas it does not protect the seedlings during 2 weeks, the Tricyclazole+ Mancozebe combination clearly improves the percentages of reduction of the symptoms of the two diseases and protects the plants from rice even 6 weeks after treatment.

Similar results were reported by Chhetry (1993) which showed that this combination is more effective against H. oryzae. According to Kline and Roanne (1972), the treatment of the barley grains by Carboxine protects them against H. gramineum. According to Chastain *et al.* (1994), the treatment of the wheat grains and the barley by Carboxine + Thirame reduces the incidence of *Puccinia recondita* and *Erisiphe graminis* and increases the number of plants per m2, the number of thalles per plant, the weight of the grains, the production of the grains and the weight of the wheat straw and the barley.

Anwar and Shafi Bhat (2005) showed that the treatment of seeds by Tricyclazole is very effective against *P. oryzae* and gives vigorous plants. Of the same, Variar *et al.* (1993) announced that tests realized in the field, on significant varieties of rice, showed that treatment of the grains of rice by Tricyclazole, with amounts higher than those used (4 g/kg of grains), followed by pulverizations of Iprophenphos to 1 l/ha reduces the incidence of the pyriculariose and increases the number of produced grains.

In addition, Froyd *et al.* (1976) reported that the application of Tricyclazole, to 1 g/kg to the grains, protects the plants of rice, against *P. oryzae*, 5 weeks after treatment.

In the same direction, works were realizedin Morocco by Ezzahiri and El Ghachtouli (1996) for the purpose of testing the effectiveness and the persistence of action of a Triazole (Triticonazole) associated with Antraquinone in treatment of the barley and wheat seeds against brown rust and the oïdium. These authors concluded that Triticonazole completely protects the plant, resulting from grains treated against brown rust of wheat and reduces the severity for approximately 50%, compared to the witness in the field, until the end of the cycle's culture. Against the oïdium, this product maintained severity neer zero-order, 73 days after sowing.

Geetha and Sivaprakasam (1993) also reported that treatment of the grains of rice by Mancozèbe (0.4%), Carboxine (0.3%) or by Tricyclazole (0.3%) inhibits *P. oryzae* and *H. oryzae*. Moreover, the application of Carboxine + Carbendazime (0.2 + 0.3%) inhibits also these pathogens. The plants resulting from the grains treated by this association and those treated by Mancozèbe are more vigorous. This last product favours also the germination of the grains of rice.

In opposition to the products discussed, Benzimidazoles through the example of Bénomyl, Methylthiophanate and Thiabendazole did not have the same effectiveness. Indeed, Bénomyl applied only to the grains at 1 g/kg of grains, is not toxic. But, this amount does not inhibit the necrotic lesions due to the two pathogens. The toxic effect of Thiabendazole, with the same amount, appears clearly on the germination of the grains. This is in conformity with the results of Kaisair and Hannan (1988) which showed that in tests realized under greenhouse, the lifting and the crop production (fresh weight of the foliage and the roots) were clearely more lowafter the treatments of the chickpea grains with Thiabendazole against Ascochytarabiei. Also, more the amounts of these two products increase, more the toxic effect appears on the three physiological stages considered (germination, length of the roots and length of the coléoptiles). The Methyl-Thiophanate is not toxic for the seeds, but its protective effect on the coléoptiles is very low.

Some authors (Aulakh *et al.*, 1974; Nyvall *et al.*, 1995; Manandhar *et al.*, l998b) mentioned a positive correlation between the infection of plants in the field and the infection of grains by *P. oryzae* and *H. oryzae*. The infected grains are often not filled. A severe infection can even prevent the grains from developing.

Finally, the treatment of the grains by the Tricyclazole+ Mancozèbe combination (1.5 G + 1.5 g/Kg of grains) gives the best results and continuous protecting the plants from rice four and five weeks, after treatment, respectively against the helminthosporiose and the pyriculariose.

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