J. Agric. Sci. Mansoura Univ., 30 (9): 5133 - 5147, 2005

CHEMICAL CONTROL OF RICE BLAST DISEASE AT DAKAHLIA GOVERNORATE

Al-Laithy, B. E. A.; A. E. A. Ismail and S. M. El-Baz
Plant Pathology Res. Inst., Agric. Res. Cent., Giza, Egypt.

ABSTRACT

Kima Z (KZ) was the most effective fungicide on mycelial growth of the causal organism of rice blast disease (*Pyricularia oryzae*) followed by Rubigan, while Copox was the lowest effective one. Hinosan and Beam, were the most effective fungicides on leaf and panicle blast infection, while Rubigan was the lowest effective one in the two investigated growing seasons 2003 and 2004. The highest plant fresh weight, plant dry weight, 1000-grain weight and yield were obtained with Hinosan and Beam, while the lowest plant dry weight, plant fresh weight, 1000-grain weight and yield were found with Rubigan in the two tested growing seasons (2003 and 2004).

INTRODUCTION

Rice blast disease caused by *Pyricularia oryzae* Cavara (*Magnaporthe grisea* (Hebert barr) is one of the major fungal diseases attacked rice crop in the world (Ou and Jennings, 1969). Chemical control of rice blast was the most effective tool in reducing yield loses caused by blast infection. Although, chemical control has hazardous effects on animals and environmental system, it considered the faster controlling factors (Ou, 1980). Many chemicals have been used to control rice blast disease. Copper compounds in the early days were followed by organomercurial compounds in the 1950 and 1960, then antibiotics and organophosphorus compounds, and most recently, systemic fungicides were detected (Ou, 1980). Chemical control of rice blast disease could be achieved by two methods, first one by seed treatment with fungicides before sowing (Takenaka and Yaman, 1990 and Varier *et al.*, 1993) and the second method include spraying rice plants with fungicides for controlling leaf blast (Sawada and Itoh, 1988 and Safulla *et al.*, 1998) or panicle blast infection (Tsuda *et al.*, 1998 and Pento and Costa, 1999). Combination of seed treatments and foliar spraying fungicide were the most effective (Hegde and Kalappanavar, 2000). Tricyclazole fungicide reduced leaf and neck blast by 37.5 and 65.3%, respectively, with increase yield compared with control treatment, while carbendazime reduced neck blast by 44.7% with 22.1% increase in yield over control treatment (Saifula *et al.*, 1998). Control of leaf blast was achieved by application of proquilon as rice blast control agent for 40 days, while control of panicle blast was achieved by application of the formulation at 13 to 34 days before heading (Tsuda *et al.*, 1998). Nursery box applications of carpropamide at 50-100 g/pox firmly reduced rice secondary infection with *P. oryzae* in the greenhouse, the application suppressed spores release from rice leaves in rice fields as well as in the greenhouse (Sakuma, 1999). The lowest incidence of neck blast was obtained by applying Trycyclazole alone or in mixtures (Santos *et al.*, 2000).

Benomyl and fentin acetate were the most effective inhibitory fungicides in spore germination and appresorial formation at much lower concentration than those required for preventing germination. Benomyl and manganese omadin were quite effective in protecting the rice seedlings from blast by their systemic action after seed treatments duration of activity been 24 and 25 days, respectively (Kapor and Singh, 1982). On the other hand, seed treatment with pyriquilon or tricyclazole (0.2%) is recommended in areas, where blast and brown leaf spot are severe (Saifula and Seshadri, 1992 and Geetha and Sivaprakasam, 1993). It is possible to protect rice plants from leaf blast by seed treatment with Beam, where leaf blast was reduced at least by 50% and plant height increased by 27% compared with the control (Rodriguez *et al.*, 1993).

Thus, this study aimed to indicate the effect of some fungicides on mycelial growth, spore germination and appressorial formation of *P. oryzae* under laboratory conditions. Furthermore, the control effect of these fungicides control under greenhouse and field conditions was investigated.

MATERIALS AND METHODS

1. Laboratory experiments:

1.1. Effect of different concentrations of eight fungicides on linear growth of *P. oryzae*:

The effect of different concentrations (0, 1, 12.5, 25, 50, 100, 125, 200, 250, 500 and 1000 ppm) of each tested fungicide was tested on the linear growth of *P. oryzae* on PDA medium. The different concentrations of each fungicide were suspended and added to PDA medium before solidifying. The medium containing the fungicide was poured in Petri dishes (9 cm in diameter) at rate of three dishes for each concentration. The dishes were inoculated in the center with equal discs (5 mm in diameter) of *P. oryzae* 7 days old culture and linear growth of *P. oryzae* was measured when mycelial growth completely covered the medium surface in the control treatment by taking two perpendicular readings in cm and averaged.

1.2. Effect of different concentrations of eight fungicides on spore germination and/or apprissorial formation of *P. oryzae*:

The previously different concentrations of each fungicide were tested on *P. oryzae* spore germination. The medium with sporulated fungus were cut into discs (1.5 cm in diameter). One disc was added to 5 ml of each concentration and then washed thoroughly. Three slides with cavity were used for each concentration. A 0.2 ml of the spore suspension was added in the cavity. Slides were kept and incubated for 12 hours (Okuno *et al.*, 1989). The slides were then examined microscopically to calculate the percentage % of spore germination. Spore was considered germination if its germ tube length was equal to the width of the spore (Zitter and Hus, 1992). Also, percentage of spores forming apprissoria was calculated.

2. Greenhouse experiments:

2.1. Effect of five fungicides as seed dressing on disease incidence.

Five fungicides i.e., Beam, Risolex-T50, Vitavax-300, KZ 50 and Topsin-M 70 were evaluated under greenhouse conditions as seed dressing at different doses (Table 1).

Table 1. Fungicides used as seed dressing and their different doses.

Fungicide	Recommended	Half dose	Quarter dose
Beam	4 gm/kg of seeds	2.0 gm/kg of seeds	1.0 gm/kg of seeds
Rizolex-T	3 gm/kg of seeds	1.5 gm/kg of seeds	0.75 gm/kg of seeds
Vitavax	2 gm/kg of seeds	1.0 gm/kg of seeds	0.50 gm/kg of seeds
KZ	3 gm/kg of seeds	1.5 gm/kg of seeds	0.75 gm/kg of seeds
Topsin-M	2 gm/kg of seeds	1.0 gm/kg of seeds	0.50 gm/kg of seeds

Seeds of Giza 171 rice cultivar were mixed with different doses of each of the five fungicides (Table 1), each separately in stoppered glass container containing 40 ml of glue suspension as sticker material / kg of seeds. The treated seeds were left to dry. Treated seeds were sown in plastic pots (20 cm in diameter) filled with field soil. Twenty rice seeds were sown in each pot. Random complete block design with three replicates for each dose was used. Plants at three weeks old (21 day) were inoculated with *P. oryzae* as mentioned before. Control treatment were treated only with glue and inoculated with *P. oryzae*. Pots were irrigated daily and disease was assessed according to Korium (1977).

2.2. Effect of five fungicides as foliar spray on disease incidence, under greenhouse conditions.

Five fungicides i.e., Beam, Hinsan, Rubigan, KZ and Copox were examined for their effect on disease incidence, under greenhouse conditions at recommended dose, double recommended dose and half-recommended dose as foliar spraying. Giza 171 rice cultivar seeds were sown in plastic pots as mentioned before. Pots were divided into two groups. First group was sprayed with the fungicides at different doses, 3 days before inoculation with *P. oryzae*. The second was sprayed with the fungicides, 3 days after inoculation with the pathogen. Plants were inoculated with *P. oryzae* at 21 days old as mentioned before. Plants were sprayed with the fungicides until it run-off. Random complete block design with three replicates for each dose was carried out.

Control treatment in each group was sprayed with distilled water. Disease assessment was carried out as mentioned before.

3. Field experiments:

Five fungicides (Beam, Hinsan, Rubigan, KZ and Copox) were examined for their effect on disease incidence, under field conditions at recommended dose. Experimental unit was 1/400 of feddan. Giza 171 rice cultivar was sown in nursery at 10th of May thirty five days old, seedling were transplanted in rows in the experimental plots. Spacing was 20 x 20 cm between rows and hills. Distances between plots were 50 cm.

Plots were sprayed with recommended doses of five fungicides three times. The first spraying was at the beginning of tilling stage, second spraying was 10 days before booting stage and third was 5 days after heading. Random complete block design was used with three replicates for each particular treatment. Control was sprayed with distilled water. All agricultural practices were followed as normal at Tag El-Ezz Agriculture Research Station Farm. Experiment was carried out under natural infection. Disease assessment was carried out according to Towsend and Huberger (1943) and Zeigler *et al.* (1994).

RESULTS

1. Laboratory experiments:

1.1. Effect of different fungicides concentrations on the growth of *P. oryzae*:

Data in Table 2 indicated that KZ was the most effective fungicide on the mycelial growth, which completely inhibited *P. oryzae* linear growth at average concentration 0.82 ppm followed by Rubigan (1.39 ppm). On the contrary, Copox was the less effective fungicide, where it inhibited *P. oryzae* linear growth at average concentration 5.71 ppm.

Data also revealed that there was clear reduction in *P. oryzae* linear growth with increasing of the concentrations of all tested fungicides. There were clear differences between most of the tested concentrations and the control.

Moreover, there were clear significant differences between the tested fungicides, their concentrations and their interaction on *P. oryzae* linear growth.

1.2. Effect of different fungicide concentrations on percentage of spore germination of *P. oryzae*:

Data in Table 3 revealed that the most effective fungicide in reduction of *P. oryzae* spore germination was Rizolex-T (10.36) followed by Rubigan (16.52%) and Vitavax (16.67%), followed by KZ (58.85). The other fungicides were moderately effective on inhibition *P. oryzae* spore germination.

Furthermore, results indicated that *P. oryzae* spore germination was completely inhibited at 12.5 ppm with Rizolex-T, 25 ppm with Vitavax and 50 ppm with Rubigan. On the contrary, there was no completely inhibition with KZ and Rizolex until 1000 ppm. The other fungicides inhibited *P. oryzae* spore germination at different concentration values. In addition, the value of *P. oryzae* spore germination decreased with increase of fungicide concentrations.

Moreover, there were clear significant differences between the tested fungicides, their concentrations and their interaction on *P. oryzae* spore germination.

Table 2. Effect of different fungicide concentrations on *P. oryzae* linear growth (cm).

Fungicides	Concentrations (ppm)										
	0	1	12.5	25	50	100	125	200	250	500	1000	Average (cm)
Bean	9.00	9.00	7.13	6.60	5.73	4.87	4.40	4.43	4.07	3.13	0.00	5.30
Vitavax-300	9.00	9.00	4.47	2.20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.24
Rizolex-T	9.00	9.00	8.03	7.13	6.53	4.77	3.17	0.00	0.00	0.00	0.00	4.33
KZ	9.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.82
Hinosan	9.00	9.00	4.47	2.60	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.28
Rubigan	9.00	6.30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.39
Topsin-M	9.00	7.87	5.30	3.27	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.31
Copox	9.00	9.00	9.00	7.37	5.53	4.93	4.67	4.40	3.87	3.77	1.27	5.71
Average	9.00	7.40	4.80	3.65	2.22	1.82	1.53	2.94	0.99	0.86	0.16	3.05

LSD at 5% for Fungicides (F) 1.046 Concentrations (C) 1.227 F x C 3.468

Table 3. Effect of different fungicide concentrations on *P. oryzae* spore germination.

Fungicides	Concentrations (ppm)										
	0	1	12.5	25	50	100	125	200	250	500	1000	Average (%)
Vitavax-300	92.00	90.33	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	16.67
Topsin-M	92.00	89.33	82.67	80.00	71.67	65.33	51.00	42.67	39.33	33.33	0.00	58.85
Bean	92.00	80.67	71.00	27.67	8.33	5.33	1.33	1.00	0.67	0.00	0.00	26.18
KZ	92.00	76.33	64.67	58.67	43.67	41.33	34.00	28.00	24.67	17.67	15.00	45.09
Rizolex-T	92.00	22.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	10.36
Rubigan	92.00	82.67	4.67	2.33	0.00	0.00	0.00	0.00	0.00	0.00	0.00	16.52
Copox	92.00	88.00	82.33	75.33	70.33	66.67	66.33	58.33	57.33	47.33	20.00	65.82
Hinosan	92.00	81.67	70.33	2.67	0.00	0.00	0.00	0.00	0.00	0.00	0.00	22.42
Average	92.00	76.38	47.08	30.83	24.26	22.33	19.08	16.26	15.25	12.29	4.38	32.74

LSD at 5% for Fungicides (F) 1.488 Concentrations (C) 1.745 F x C 4.937

1.3. Effect of different fungicide concentrations on percentage of appressorial formation of *P. oryzae* spores:

Results in Table 4 reveal that the most effective fungicide reduced % appressorial was Rizolex-T, followed by Hinosan. While, Copox was the least effective one.

Data also indicate that Rizolex-T completely inhibited appressorial formation at 1 ppm, the same trend was obtained with Rubigan at 12.5 ppm. On the other hand, Copox inhibited apprissorial formation at 500 ppm.

Furthermore, all fungicides decreased apprissorial formation at different concentrations compared with the control. Apprissorial formation was decreased with increasing concentrations.

Moreover, there were significant differences between fungicides and concentrations. The same trend was obtained in fungicides and concentration interaction.

2. Greenhouse experiment:

2.1. Effect of different fungicides doses as seed dressing on rice blast disease incidence:

Data in Table 5 indicate that Beam was the most effective fungicide for controlling the pathogen of the blast disease followed by KZ and Topsin-M. On the other hand, the lowest effective one was Rizolex-T 50.

Data also show that all tested fungicides reduced disease incidence (whole plant lesions and disease severity) compared with the control. Disease incidence was decreased with increasing fungicide doses.

Moreover, the lowest whole plant lesion (4.00) and disease severity (8.00) were found with Beam at dose 4 gm/kg of seeds followed by KZ at dose 3 gm/kg of seeds. On the other hand, the highest whole plant lesion (14.44) and disease severity (68.00) were noticed with rhizolex-T at dose 0.75 gm/kg of seeds.

Generally, there were significant differences between fungicides and their doses especially between control treatment and the other doses. Furthermore, the differences were significant between doses and fungicide interaction.

2.2. Effect of spraying rice plants with different fungicides doses on rice blast disease incidence:

Data presented in Table 6 reveal that spraying rice plants by different fungicides for three days before inoculation was the most effective method comparing with spraying after inoculation with pathogen. In addition, Beam was the most effective fungicide in reducing disease incidence followed by Hinsan in two spraying times. On the other hand, Copox was the lowest effective tested fungicide on reducing disease incidence.

Furthermore, disease incidence decreased with increasing fungicide doses. All tested fungicides reduced disease incidence when comparing with control treatment.

There were significant differences between fungicides, concentrations, spraying times and their interaction in whole plant lesions and disease severity.

Table 4. Effect of different fungicide concentrations on % of appressorial formation of *P. oryzae* spores.

Fungicides	Concentrations (ppm)										
	0	1	12.5	25	50	100	125	200	250	500	1000	Average (%)
Vitavax-300	83.67	52.00	20.33	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	14.18
Topsin-M	83.67	22.33	14.33	8.33	4.33	3.67	0.00	0.00	0.00	0.00	0.00	12.42
Bean	83.67	71.00	16.67	9.33	8.33	0.00	0.00	0.00	0.00	0.00	0.00	17.18
KZ	83.67	30.00	22.00	17.00	11.33	9.67	3.67	0.00	0.00	0.00	0.00	16.12
Rizolex-T	83.67	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	7.61
Rubigan	83.67	50.33	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	12.18
Copox	83.67	56.67	49.00	41.67	25.33	17.33	16.00	14.33	12.33	0.00	0.00	28.76
Hinosan	83.67	16.33	17.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	10.36
Average	83.67	37.33	17.42	9.54	6.17	3.83	2.46	1.79	1.54	0.00	0.00	14.85

LSD at 5% for Fungicides (F) 2.576 Concentrations (C) 3.021 F x C 8.544

Table 5. Effect of different fungicide doses as seed dressing on rice blast disease incidence, under greenhouse conditions.

Fungicides	Doses (gm/kg of seeds)	Whole plant lesions	Disease severity
Beam	0	16.33	97.33
	1	9.78	40.00
	2	5.67	18.00
	4	4.00	8.00
	Average	8.95	40.83
Topsin-M	0	16.33	97.33
	0.5	11.11	44.00
	1	9.33	30.00
	2	6.44	14.00
	Average	10.80	46.33
KZ	0	16.33	97.33
	0.75	11.11	40.00
	1.5	8.00	24.00
	3	4.67	9.33
	Average	10.03	42.67
Rizoiex-T	0	16.33	97.33
	0.75	14.44	68.00
	1.5	10.78	53.33
	3	9.00	21.00
	Average	12.64	59.92
Vitavax-300	0	16.33	97.33
	0.5	10.00	49.33
	1	8.87	25.00
	2	6.89	12.67
	Average	10.52	46.08
General average		10.59	47.17
LSD at 5% for:	Fungicides (F)	0.673	3.076
	Doses (D)	0.602	2.751
	F x D	1.346	6.151

3. Field experiments:

3.1. Effect of spraying rice plants with five fungicides with rice blast disease incidence:

Data presented in Table 7 show that the most effective fungicide on leaf infection was Hinosan followed by Beam. On the other hand, Rubigan was the lowest effective one on leaf infection. In addition, all tested fungicides reduced leaf infection comparing with the control.

Furthermore, in case of panicle infection, Beam was the most effective fungicide followed by Hinosan. While, Rubigan was the lowest effective fungicide on panicle infection. All tested fungicides reduced panicle infection comparing with the control one.

Table 6. Effect of spraying rice plants with different fungicide doses on rice blast disease incidence, under greenhouse conditions.

Fungicides	Doses (gm/kg of seeds)	Whole plant lesions		Disease severity	
		Three days before infection	Three days after infection	Three days before infection	Three days after infection
Beam	0	17.00	17.44	91.00	95.00
	0.5	4.22	8.28	10.00	32.00
	1	0.78	6.89	2.67	15.00
	2	0.00	3.56	0.00	5.00
	Average	0.50	9.04	25.92	36.75
Hinosan	0	17.00	17.44	91.00	95.00
	0.5	5.11	9.33	8.00	29.00
	1	2.00	7.87	3.00	18.00
	2	0.00	4.11	0.00	8.00
	Average	6.03	9.69	25.50	37.50
KZ	0	17.00	17.44	91.00	95.00
	0.5	10.44	11.22	29.67	38.67
	1	6.11	9.44	22.00	30.67
	2	1.98	6.78	6.67	21.67
	Average	8.88	11.22	37.34	22.75
Rubigan	0	17.00	17.44	91.00	95.00
	0.5	10.44	11.78	41.67	56.67
	1	7.44	9.22	26.33	37.67
	2	2.78	7.67	6.67	25.00
	Average	9.42	11.53	41.42	53.59
Copox	0	17.00	17.44	91.00	95.00
	0.5	13.11	14.67	52.67	79.00
	1	11.11	12.11	48.33	50.67
	2	8.11	10.11	25.33	43.33
	Average	12.33	13.58	42.11	67.00
General average		8.43	11.01	34.46	43.52

LSD at 5% for:			
	Spraying time (ST)	0.429	1.801
	Fungicides (F)	0.678	2.848
	Doses (D)	0.606	2.548
	ST x F	0.959	4.028
	ST x D	0.857	3.603
	F x D	1.356	5.697
	ST x F x D	1.917	8.058

Generally, in case of leaf infection and panicle infection severity, leaf infection percentage and panicle infection severity, there was difference between the two seasons the tested fungicides and control one. Also, there was a significant difference between Beam and Hinosan rather than other tested fungicides.

Table 7: Effect of spraying rice plants with five different fungicides with rice blast disease incidence under field conditions.

Fungicide	Leaf infection severity			Leaf infection percentage			Lesion number / leaf			Panicle infection severity			Panicle infection percentage			Neck infection percentage		
	2003	2004	Mean	2003	2004	Mean	2003	2004	Mean	2003	2004	Mean	2003	2004	Mean	2003	2004	Mean
Beam	3.93	2.17	3.05	15.00	13.33	14.17	7.00	6.50	6.75	18.80	14.43	16.62	25.00	23.67	23.43	7.67	7.33	7.50
Hinosan	3.30	1.23	2.27	14.67	13.33	14.00	5.33	4.20	4.77	26.70	16.30	21.50	29.67	26.67	28.17	12.00	9.67	10.84
KZ	6.90	5.27	6.09	32.67	33.33	33.00	13.67	9.60	11.74	39.43	39.40	39.42	42.67	35.00	38.84	16.67	15.00	15.84
Copox	8.17	7.20	7.69	24.33	32.00	28.17	17.10	15.30	16.20	36.83	21.70	29.27	46.67	46.33	46.50	21.67	18.33	20.00
Rubigan	9.03	11.63	10.33	37.33	36.67	37.00	19.50	18.33	18.92	46.83	43.17	45.00	56.33	45.33	50.83	22.00	20.00	21.00
Control	16.83	16.83	16.72	57.33	51.67	54.50	22.75	22.47	22.61	54.07	62.73	58.40	68.33	61.33	64.38	29.67	23.33	26.50
Average	8.03	7.35	7.69	30.22	30.06	30.14	14.20	12.77	13.50	37.11	32.90	35.04	44.78	39.72	42.19	18.28	15.61	16.95

LSD at 5% for

	Leaf infection severity	Leaf infection percentage	Lesion number / leaf	Panicle infection severity	Panicle infection percentage	Neck infection percentage
Season (S)	3.72	5.09	1.49	6.32	4.64	1.52
Fungicide (F)	6.44	8.82	2.58	10.95	8.03	2.69
S x F	9.11	12.47	3.65	15.49	11.36	3.80

Table 8: Effect of spraying rice plants with five different fungicides on some growth parameters and yield under field conditions.

Fungicide	Plant fresh weight (gm)			Plant dry weight (gm)			Leaf area (cm^2)			1000-grain weight (gm)			Yield (kg/m^2)			Plant height (cm)		
	2003	2004	Mean	2003	2004	Mean	2003	2004	Mean	2003	2004	Mean	2003	2004	Mean	2003	2004	Mean
Beam	17.79	18.71	18.25	7.16	6.56	6.86	51.31	48.20	49.76	25.91	25.15	25.03	1.00	1.00	1.00	128.37	121.80	125.09
Hinosan	17.58	17.25	17.42	7.30	6.25	6.78	44.51	52.20	48.36	25.99	24.20	25.10	1.02	0.99	1.01	125.97	120.90	123.44
KZ	16.55	17.00	16.78	6.38	5.21	5.80	50.90	45.80	48.35	24.27	23.24	23.76	0.80	0.87	0.83	125.86	106.00	116.23
Copox	17.12	16.26	16.69	6.60	5.55	6.08	53.18	45.25	49.22	24.70	23.85	24.28	0.90	0.77	0.83	124.17	120.00	122.09
Rubigan	17.18	16.42	16.60	6.25	5.07	5.66	53.71	43.80	48.76	24.70	22.00	23.35	0.81	0.76	0.79	124.13	120.50	122.32
Control	15.84	15.55	15.70	5.45	4.48	5.15	43.23	40.60	41.92	23.72	20.46	22.09	0.72	0.66	0.69	112.93	114.60	113.77
Average	17.01	16.87	16.94	6.25	5.58	6.06	49.47	45.98	47.73	24.88	22.98	23.94	0.88	0.84	0.86	123.57	117.40	120.49

LSD at 5% for

	Plant fresh weight	Plant dry weight	Leaf area	1000-grain weight	Yield	Plant height
Season (S)	0.67	0.42	4.85	1.37	0.08	4.85
Fungicide (F)	1.15	0.71	8.40	2.37	0.14	8.41
S x F	1.63	1.01	11.88	3.36	0.20	11.89

In case of lesion number per leaf, panicle infection percentage and neck infection percentage. there were significant differences between the two seasons for both fungicides Beam and Hinosan. Also, there were significant differences between all tested fungicides and control. In addition, significant differences were found between seasons and fungicide interaction.

3.2. Effect of spraying rice plants with five fungicides on some growth parameters and yield:

Data presented in Table 8 indicate that the highest plant fresh weight (18.25 gm) and dry weight (6.86 gm) were obtained with Beam followed by Hinosan. While, the lowest plant fresh weight (16.69 gm) were observed with Copox and dry weight (5.66 gm) were noticed with Rubigan.

Moreover, the highest 1000-grain weight (25.10 gm) and yield (1.006 kg/m^2) were obtained with Hinosan. While, 1000-grain weight (23.35 gm) and yield (0.787 kg/m^2) were found with Rubigan. In addition, the highest leaf area (49.76 cm^2) and plant height (125.09 cm) were obtained with Beam, while the lowest leaf area (48.35 cm^2) and plant height (116.23 cm) were recorded with KZ.

There were non-significant between the growing seasons. While, there was significant differences between fungicides in case of yield, but the differences were not significant concerning leaf area.

Furthermore, the difference between the two growing seasons and/or fungicides were significant for 1000-grain weight. Also, there were significant differences growing seasons and fungicides with plant fresh weight, dry weight and plant length. There were significant differences between tested fungicides and the control treatment for all tested plant parameters, except for those of leaf area.

DISCUSSION

Eight fungicides were tested in laboratory for their effect on the linear growth, spore germination and appressorial formation of *P. oryzae*. KZ, Rubigan, Vitavax-300 and Hinosan were the most effective fungicides on the mycelial growth, while Copox and Beam were the lowest effective. On the other hand, Resolex-T, Vitavax-300, Rubigan and Hinosan were the most effective fungicides on spore germination and appresorial formation of *P. oryzae*, while Copox and KZ were the lowest effective. Similar results were obtained by El-Kazzaz *et al.* (1990); Mustaq, Ahmed (1992) and Kurahashi and Penzen (1998).

These results indicated that the tested fungicides differed in their reaction against *P. oryzae*. Differences in reaction might be due to the selective reaction between fungicide and fungus (Singh and Siradhama, 1990). Also, the effect of fungicides might be due to inhibition of melanin biosynthesis, leakage of some electrolytes from spores or mycelia, affecting the respiratory activity and destroy membranes functions (Okuno *et al.*, 1989a, b and Woloshuk *et al.*, 1981). Five fungicides (Beam, Hinosan, KZ, Rubigan and Copox) were tested for their effects on rice blast disease incidence, under greenhouse conditions, as aerial spraying three days before and/or after inoculation with the pathogen at three doses of each fungicide. Results indicated that the tested fungicides reduced disease incidence when used three days before inoculation than three days after inoculation with *P. oryzae*. Also, disease incidence decreased with increasing fungicide doses. Such results revealed that Beam and Hinosan were the most effective fungicides, while Copox and Rubigan were the lowest effective ones. These results are in harmony with those obtained by Kurahashi and Hanssler (1998); Sawada and Itoh (1998); Rongaming *et al.* (1998); Pinto and Costa (1999) and Sakuma (1999).

The previously mentioned fungicides were also tested their recommended doses, under field condition, for their effects on rice blast disease incidence. The obtained results indicated that Beam and Hinosan were the most effective fungicides, while Copox and Rubigan were the lowest effective ones. These results were on line with those obtained by Saifulla *et al.* (1994); Dubey (1995); Nemot *et al.* (1995); Davi (1997); Miyasak *et al.* (1998); Saifulla *et al.* (1998) ; Srivastava (1999) and Santos *et al.* (2000). The results presented here demonstrated that the action of such fungicides might be due to its directly toxic effect to the fungus, reduce spore adhesion to lead surface and influence the initiation of infection structures. The difference between two spraying times (three days after and/or before inoculation) might be due to the increase in enzymes related to the resistance reaction, Peroxidase, Polypheoloxidase, Phenylalanine ammonialyase, tyrosine ammonialyase and catechol-O-methyltransferase (Iwata *et al.*, 1980), or antigungal substances might be produced in leaves treated with the fungicide (Shiba and Nagata, 1981). Also, a fungicide might be improves the ability of rice plants defence system to respond to infection (Kurahashi and Hanssler, 1998 and Talbot, 1995). Such results suggested considerable potential for environmentally benign strategies for the control of rice blast disease based on anti-adhesion compounds under field conditions.

The explanation of differences between fungicides used at the same time might be due to the differences in the fungicide mode of action and their selective harmful effect on the pathogen metabolism or killing the pathogen (Sharvelle, 1961). Five fungicides (Beam, KZ, Rizolex-T, Vitavax-300 and Topsin-M70) were tested for their effect on rice blast disease incidence as seed treatments, under greenhouse conditions. Each fungicide was tested at three different doses. Results showed that the effect of the fungicides increased with increasing the dose. It is also clear from data that Beam was the most effective fungicide, while Rizolex-T was the lowest effective on controlling rice blast disease under greenhouse conditions. Several investigators; Kapor and Singh (1982), Praphu (1985), Aurica (1987), Singh and Bhatt (1987), Loehken (1990), Safulla and Seshadri (1992), Rodriguez *et al.* (1993) and Sinha and Chowdhury (1993) obtained similar results.

The explanation of such results might be due to the differences in the fungicide mode of action, their selective harmful effect on pathogen metabolism or kill the pathogen (Okuno *et al.*, 1989b). The effect of seed treatments might be due to systemic action and duration activity of the fungicides (Kapor and Singh, 1982 and Sinha and Chowdhury, 1993). Fungicides might be also absorbed by seeds and translocated during germination to roots and shoots (Bhatt *et al.*, 1994). Thus, it could be concluded that mechanism of such fungicides was shown to be protective at these concentrations, the fungicide blocked *P. oryzae* induced appressorial melanization and plant cell wall penetration and thus induces resistance in rice plants resulting the best morphological characters and high yield production.

REFERENCES

Aurica, S. (1987). Results of chemical control of rice blight (*Pyricularia oryzae*). Problem de Protectia de Plantelor, 15(1):15-17. (C.F. Rev. Pl. Pathol., 67(7):3443).

Bhatt, J.C.; R.A. Singh and U.S. Singh (1994). Uptake, translocation and persistence of Pyroquilon in rice plant after seed treatment. Indian Phytopathol., 47(3):260-262. (C.F. Rev. Pl. Pathol., 74(10):6344).

Devi, G.U. (1997). Chemical control of ragi blast. Indian J. Pl. Prot., 25(1):73-74. (C.F. Rev. Pl. Pathol., 78(1):379).

Dubey, S.C. (1995). Evaluation of different fungitoxicants against blast of rice. Plant Disease Res., 10(1):38-41. (C.F. Rev. Pl. Pathol., 75(6):3778).

El-Kazzaz, M.K.; Z.H. Osman; M.R. Sehly and S. Badr (1990a). Chemical control of rice blast disease. Agric. Res. Rev., 68(3):491-500 (C.F. Rev. Pl. Pathol., 73(2):948).

Geetha, D. and Sivaprakasam (1993). Treating rice seeds with fungicides and antagonists to control seed born disease. Inter. Rice Res. Notes, 18(3):30-31. (C.F. Rev. Pl. Pathol., 74(1):260).

Hegde, Y.R. and I.K. Kalappanavar (2000). Management of blast of rice. Adv. Agric. Res. India, 14:157-159.

Iwata, M.; Y. Suzuki; T. Watanabe; S. Mase and Y. Sekizawa (1980). Effect of probenazole on the activities of enzymes related to the resistant reaction in rice plants. Ann. Phytopathol. Soc. Japan, 46(3):297-306.

Kapor, A.S. and B.M. Singh (1982). Evaluation of some fungicides for the control of rice blast. Indian Phytopathol., 35(4):558-561 (C.F. Rev. Pl. Pathol., 64(1):181).

Korium, A.M. (1977). Studies on rice blast disease caused by *Pyricularia oryzae* in the ARE. M.Sc Thesis, Fac. Agric., Zagazig Univ., Egypt.

Kurahashi, Y. and G., Hanssler (1998). WIN ® (Carpropamide) an ideal fungicide for nursery-box treatment. Pflanzenschutz-Nachrichten Bayer, 51(3):209-220. (C.F. Rev. Pl. Pathol., 78(8):5424).

Kurahashi, Y. and R. Pontzen (1998). Carpropamid: a new melanin biosynthesis inhibitor. Pflanzenschutz-Nachrichten Bayer, 51(3):247-258. (C.F. Rev. Pl. Pathol., 78(8):5101).

Loehken, A. (1990). The benefits of seed/early season fungicide application for the management of rice blast (*Pyricularia oryzae*). Barking, UK; Elsevier Applied Science Publishers Ltd., 71-86. (C.F. Rev. Pl. Pathol., 72(9):5961).

Miyaska, A.; R. Sonoda and H. Naito (1998). Occurrence and chemical control of seed borne diseases of rice in hydroponically raised seedlings for long mat type rice cultivation. Proceedings of the Kanto-Tosan, Pl. Prot. Soc., 45:23-25. (C.F. Rev. Pl. Pathol., 78:1973).

Mustaq Ahmed (1992). Control of rice blast by foliar fungicidal sprays. Plant Disease Res., 7(1):24-32. (C.F. Rev. Pl. Pathol., 72(12):8378).

Nemoto, F.; H. Naito; N. Hayashi; T. Furukawa; Y. Maruyama and Y. Sarro (1995). Efficient control of rice blast by radin tractor for crop management in direct seeding Paddy fields. Proceedings of the Konato-Tosan, Pl. Prot. Soc., 42:35-38. (C.F. Rev. Pl. Pathol., 75(10):6544).

Okuno, T.; I Furusawa; K. Matsuura and J. Shishiyama (1989a). Made of action of ferimson (TF-164), anovel systemic fungicide for rice disease effects on the general metabolism of *Pyricularia oryzae*. Ann. Phytopathol. Soc. Japan, 55(3):281-289. (C.F. Rev. Pl. Pathol., 69(5):2337).

Okuno, T.; I. Furusawa; K. Matsuura and J. Shishiyama (1989a). Made of action of ferimzone, a novel systemic fungicide for rice disease. Effect of general metabolism of *Pyricularia oryzae*. Ann. Phytophathol. Sci. Japan (In Press).

Ou, S.H. (1980). A look at worldwide rice blast disease control. Plant Disease, 64(5):439-445.

Ou, S.H. and P.R. Jenning (1969). Annu. Rev. Phytopathol., 7:383.

Pinto, N.F.J. and Costa, E.F. (1999). Fungicide applications by over head sprinkler irrigation for the control of blast disease of rice (*Pyricularia oryzae*). Summa Phytopathologica, 25(2):167-171. (C.F. Rev. Pl. Pathol., 79:1769).

Prabhu, A.S. (1985). Evaluation of Pyroquilon seed treatment for blast (B_1) control in upland rice. International Rice Res. Newsletter, 10(1):13. (C.F. Rev. Pl. Pathol., 65(5):1878).

Rongming, Y.; Z. Mingguo and Y. Zhongyin (1998). Action mode of Tricyclazole against rice blast. J. Nan Jing Agric. Univ., 21(2):34-37. (C.F. Rev. Pl. Pathol., 77(11):9183).

Rodriguez, H.A.; H. Nass and I.A. De Rodriguez (1993). Seed treatment with fungicides for controlling leaf blast on rice. Fitopatologia Venezolana, 6(2):38-40. (C.F. Rev. Pl. Pathol., 75(6):3777).

Saifulla, M. (1994). Evaluation of granular fungicides against rice blast disease. Plant Prot. Bull. (Faridabad), 46(1):22-23. (C.F. Rev. Pl. Pathol., 75(8):5222).

Saifula, M. and V.S. Seshadri (1992). Chemical control of rice seedling blast. Pl. Prot. Bull., 44(3):45-47. (C.F. Rev. Pl. Pathol., 10:6733).

Saifula, M.; H.K. Ramappa; N. Shivakumar and N.M. Poonacha (1998). A new promising fungicide for the control of rice blast disease. *Oryzae*, 35(2):188-189. (C.F. Rev. Pl. Pathol., 77(12):10047).

Sakuma, H. (1999). Effect of nursery box application of carpropamid (WIN ® 4GR) on the secondary infection and spore liberation of rice blast fungus. Ann. Report. Soc. Prot. North Japan, 50:32-34. (C.F. Rev. Pl. Pathol., 79:3468).

Santos, G.R. Dos; E.M. De Carevalho and J.M. Peluzio (2000). Reaction of rice liens and cultivars to grain brown spots and blast under field conditions in Tocantins, Brazil. Revista Ceres, 47(270):125-133. (C.F. Rev. Pl. Pathol., 79:8781).

Sawada, H. and H. Itoh (1998). WIN ® (carpropamid, KTU 3616). A new systemic compound for rice blast contol. Agrochemicals Japan, 72:17-18. (C.F. Rev. Pl. Pathol., 78(1):392).

Sharvelle, E.G. (1961). The nature of uses of modern fungicides. Buryess Publ. Company Co., Minneabolis, 308 Paper.

Singh, R.A. and J.C. Bhatt (1986). Effect of seed treatment with systemic fungicides on the incidence of foliar blast on rice. Indian J. Mycol. Pl. Pathol., 16(3):249-252. (C.F. Rev. Pl. Pathol., 67(11):5453).

Singh, S.D. and B.S. Siradhama (1990). Laboratory evaluation of fungicides against *Cephalosporium maydis* causing late wilt of maize. Pesticides, 22(10):33-34. (C.F. Indian Pl. Pathol., 69(8):606, 4928).

Srivastava, L.S. (1999). Management of rice blast through fungitoxicants in Sikkim. J. Hill Res., 12(2):164-165. (C.F. Rev. Pl. Pathol., 79:4314).

Takenaka, M. and I. Yamane (1990). Pefurazoate (Healthied, UHF-8615), a new seed fungicide for rice. Japan Pesticide Information, 57:33-36. (C.F. Rev. Pl. Pathol., 71(10):6211).

Talbot, N.J. (1995). Having a blast: Exploring the pathogenicity of *Magnaporthe grisea*. Trends Microbiol., 3:9-16.

Towsend, G.R. and J.W. Huberger (1943). Methods for estimating losses caused by diseases in fungicide experiments. The Plant Diseases Report, 27(17):340-343.

Tsuda, M.; H. Ohta; T. Takahi; K. Tanizawa; A. Kunitomo; Y. Tsujino; H. Tanaka; T. Miura and S. Kato (1998). Rice blast control with a thro-win packed formulation containing Pyroquilon. J. Pesticide Sci., 23(3):230-234.

Variar, M.; D. Maiti and V.D. Shukla (1993). Efficacy of combination of fungicide formulations on management of rice blast (*Pyricularia oryzae*) in rainfed upland. Indian J. Agric. Sci., 63(6):386-389. (C.F. Rev. Pl. Pathol., 74(3):1438).

Zeigler, R.S.; S.A. Leong and P.S. Teng (1994). Rice blast disease. CAB International; International Rice Research Institute, Printed and Bounded in the UK at the Univ. Press, Cambridge, PP. 363.

المقاومة الكيميائية لمرض اللفحة فى الأرز

بهاء الكردى أحمد الليثى – عادل الصادق أحمد إسماعيل – سحر محمد الباز
معهد بحوث أمراض النباتات – مركز البحوث الزراعية – الجيزة – مصر

في دراسة المقاومة الحيوية لمرض اللفحة فى الأرز بإستخدام بعض المبيدات الفطرية أوضحت أن المبيد الفطرى كيما زد أكثر المبيدات الفطرية المختبرة تأثيرا على النمو الخطى للمسبب المرضى بيريكيولاريا أورايزا ثم تلاه الربيجان وكان أقلها تأثيرا المبيد الفطرى كوبكس. كما أوضحت الدراسات أن مبيدى الهينوزان والبيم أكثر المبيدات الفطرية تأثيرا على الإصابة بلفحة الأوراق والسنابل فى حين أن الروبيجان كان أقلها تأثيرا وذلك خلال موسمى الزراعة ٢٠٠٣ ، ٢٠٠٤ . ولقد تم تقدير أعلى وزن رطب ووزن جاف ووزن ١٠٠ حبة والمحصول.