Biological control of rice disease and insect by chitinase-producing bacterium X2-23

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Enriched by the medium containing chitin and cell wall of *Rhizoctonia solani* AG-1, a bacterium X2-23 with higher chitinase activity was isolated from 166 chitinase-producing bacteria. It could distinctly inhibit the fungi growth of some plant pathogens such as *R. solani*, *Magnaporth griesa*, *Fusarium moniliforme*, *F. geaminearum*, *Scleretimia sclerotiorum*, and *Xanthomonas oryzae* pv. *oryzae*. When X2-23 was added into the liquid substrates of the above fungi, phenomena such as twisting, deformation, massed and uneven cytoplasm, exosmosis or bareness happened on the protoplasts. The chitinase activities measured by limpid loop method (ratios of diameters of limpid loop R2 to diameters of conlonies R1) and Boller method were 4.89 and 25.5 U/ml, respectively. X2-23 could promote rice growth markedly, with an increase of shoot dry weight of 14.38%, root dry weight of 56.79%, and plant height of 18.94% (Table 1). Biological control test in the field indicated that the biological control effects of X2-23, the mixed culture M1 (X2-23 and nonchitinase-producing bacterium 2-29), M2 (X2 and little chitinase-producing bacterium 3-1), and Jinggangmycin against rice sheath blight were 66.02%, 77.76%, 83.21%, and 81.51%, respectively (Table 2). In addition, X2-23 performed the resistant effect on the rice leaffolder, *Cnaphalocrocis medinalis*, the control effect was at least 90%. X2-23 was systematically identified as one of the varieties of *Bacillus globisporus*, and one of new chitinase-producing strains and biological control bacteria. □

Table 1. Promotion of X2-23 on the growth of rice seedlings (4 replications).

Treatment	Plant height (cm)	Increase rate (%)	Shoot dry weight (mg/seedling)	Increase rate(%)	Root dry weight (mg/seedling)	Increase rate(%)
X2-23	22.00	18.94	8.83	14.38	2.17	14.81
CK(water)	11.51	–	7.72	–	1.89	–

Table 2. Control effect of different fermentation against rice sheath blight (Wenjiang, 2001).

Strain	Diseased plant rate(%)	Diseased hill rate(%)	Diseased index	Control effect(%)
X2-23	51.76	87.50	0.2925	66.02
M1(X2-23 and 2-29)	30.67	79.17	0.1914	77.76
M2(X2-23 and 3-1)	27.03	75.00	0.1445	83.21
Jinggangmycin	30.38	87.50	0.1592	81.51
CK(water)	90.52	100.00	0.8608	–

The insecticide resistance in two planthoppers from three areas to three insecticides

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Migrating insects brown planthopper (BPH), *Nilaparvata lugens* Stål and white-backed planthopper (WBPH), *Sogatella furcifera* Horvath are both most harmful insects on rice in China. Chemical control is thought to be the best way to manage them, but it may cause insecticide resistance. Methamidophos, buprofezin, and imidacloprid were the three insecticides often used. In 2000 and 2001, resistance of the field populations collected from three areas, i.e. Dongtai, Jiangsu Province, Anqing, Anhui Province, and Guilin, Guangxi Autonomous Region, to the three insecticides was monitored. The toxicities of the three insecticides were determined with the female adult (3 - 5 d after emergence) and by the topical application method with the hand microapplicator.

A droplet of 0.04 μl acetone solution of insecticides was applied topically to the dorsal surface of the thorax of each female adult that had been anesthetized with carbon dioxide; thirty insects were treated for each concentration with 3 replications. The control used was acetone alone instead of insecticide solution.

For BPH, the b values of the three insecticides in two years were all bigger than 3.0 and the difference of LD_{50} between the two years was not significant in susceptible strain (JAAS) (Table 1). So, LD-p lines of 2001 could be recommended as the toxicity base lines of the three insecticides to BPH.

For WBPH, the b values of methamidophos and buprofezin in the two years were both bigger than 3.5, and the difference of the LD_{50} between the two years was not significant in JAAS (Table 2). So, the LD-p lines of 2001 also could be recommended as the toxicity base lines of the two insecticides to WBPH. Although the b value of imidacloprid was 2.4 - 2.6, the LD_{50} of the two years were small and the difference was also not significant in strain JAAS. So, the LD-p line of JAAS to imidacloprid could be recommended as the toxicity base lines of imidacloprid to WBPH too.

Resistances of the three insecticides to BPH and WBPH were low. Migration was regarded as the first reason. Through migrating, the resistant gene(s) could be diluted, and the resistance declined and approached each other.□

Table 1. Resistance of BPH from the three areas to the three insecticides[a].

Insecticide	Strain	Year	LD-p line	LD_{50} (μg/female)	RR
Methamidophos	JAAS	2000	y = 13.6728 + 3.8753x	0.005763	
		2001	y = 13.8336 + 3.7288x	0.004276	
	Dongtai	2000	y = 9.1069 + 2.3958x	0.019310	
		2001	y = 10.0284 + 2.7304x	0.014419	3.35
	Anqing	2000	y = 7.7328 + 1.8801x	0.035193	
		2001	y = 9.5614 + 2.5143x	0.015341	6.11
	Guilin	2000	y = 13.2749 + 3.9673x	0.008208	
		2001	y = 9.9332 + 2.4982x	0.010608	1.42
Buprofezin	JAAS	2000	y = 13.6048 + 3.5732x	0.003907	
		2001	y = 13.2024 + 3.4472x	0.004174	
	Dongtai	2000	y = 9.0062 + 2.3722x	0.020473	
		2001	y = 8.7393 + 2.2286x	0.020995	5.24
	Anqing	2000	y = 8.3655 + 2.1608x	0.027701	
		2001	y = 8.0888 + 1.9582x	0.026463	7.09
	Guilin	2000	y = 9.2468 + 2.8033x	0.030553	
		2001	y = 9.1963 + 2.7316x	0.029093	7.82
Imidacloprid	JAAS	2000	y = 18.4670 + 3.2296x	0.000068	
		2001	y = 17.7324 + 3.0867x	0.000075	
	Dongtai	2000	y = 13.1465 + 2.3344x	0.000324	
		2001	y = 11.7241 + 2.0834x	0.000592	4.76
	Anqing	2000	y = 11.7624 + 2.0326x	0.000471	
		2001	y = 12.1574 + 2.2414x	0.000641	6.93
	Guilin	2000	y = 15.0181 + 2.5559x	0.000120	
		2001	y = 13.5367 + 2.4705x	0.000350	1.76

[a] RR was the ratio of the LD_{50} of one strain to the LD_{50} of the susceptible strain (JAAS).

Table 2. Resistance of WBPH from the three areas to the three insecticides.

Insecticide	Strain	Year	LD-p line	LD_{50} (μg/female)	RR
Methamidophos	JAAS	2000	y = 14.0377 + 4.1103x	0.006327	
		2001	y = 14.4835 + 4.0783x	0.004706	
	Dongtai	2000	y = 12.1995 + 3.8958x	0.014190	
		2001	y = 10.4781 + 3.1754x	0.018829	2.24
	Anqing	2000	y = 7.2376 + 1.7876x	0.056010	
		2001	y = 10.1295 + 3.0215x	0.020060	8.85
	Guilin	2000	y = 9.9891 + 2.5415x	0.010888	
		2001	y = 11.2105 + 3.4276x	0.015420	1.72
Buprofezin	JAAS	2000	y = 14.9889 + 3.8324x	0.002475	
		2001	y = 14.3932 + 3.6407x	0.002630	
	Dongtai	2000	y = 10.1836 + 2.7743x	0.013538	
		2001	y = 9.5090 + 2.4319x	0.013992	5.47
	Anqing	2000	y = 9.5060 + 2.5438x	0.016929	
		2001	y = 9.5764 + 2.6602x	0.019041	6.84
	Guilin	2000	y = 10.2284 + 3.0046x	0.018191	
		2001	y = 9.8658 + 2.8760x	0.020330	7.35
Imidacloprid	JAAS	2000	y = 16.4738 + 2.5286x	0.000029	
		2001	y = 15.7925 + 2.4937x	0.000047	
	Dongtai	2000	y = 12.2438 + 1.9136x	0.000164	
		2001	y = 14.2488 + 2.6304x	0.000305	5.66
	Anqing	2000	y = 11.7634 + 1.9012x	0.000277	
		2001	y = 12.5530 + 2.2943x	0.000510	9.55
	Guilin	2000	y = 14.2084 + 2.0429x	0.000031	
		2001	y = 13.8799 + 2.3047x	0.000140	1.07

Physiological traits of hybrid rice (*Oryza sativa* L.) associated with iron toxicity

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Iron toxicity, a physiological disorder of rice, is widely spread in tropical and subtropical areas and causes severe rice yield reduction. Although there has been a considerable amount of research on rice growth, nutrient uptaking, and physiological metabolisms as affected by iron toxicity, little information is available on the physiological response to excess ferrous iron of hybrid rice which is commonly cultivated in China. So, the present investigation was undertaken to study the growth and protective enzyme activities under excess ferrous iron supply conditions in hybrid rice.

Solution culture was conducted with hybrid rice Shanyou 64 subjected to five excess ferrous iron levels: 2, 50, 150, 250, and 350 mg · L^{-1} $FeSO_4 \cdot 7H_2O$ supplied along with standard rice nutrient solution (Yoshida,