

Seed treatment and inhibition of plant pathology of chitosan

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Abstract— A 0.1% solution of chitosan was studied as seed soaking agent for cotton and maize. Chitosan will help stimulate the seeds of cotton and maize for sprouting. It can also restrain the fusarium oxysporin and verticillium, then inhibit the cotton wilt and maize smut. The annual output of cotton and maize increased by 11.8% and 20.4%, respectively.

Keywords: chitosan; cotton; maize; seed treatment.

1 Introduction

The chitin is a general biological component in nature. It obtained by a waste materials of process crab and shrimp. The chitosan is a derivative of part deacetylated chitin. It showed the abilities of inhibiting the virulent pathogen of plant, and provoking the bud of wheat seed (Hadwiger, 1984; Allan, 1979; Stossel, 1984; Pearce, 1982). It can be used as the plant growth regulator for increasing the yield bean (Pospieszny, 1989; Isamu, 1989).

The chitosan is a non-toxic natural polysaccharide and possesses by the property of forming film and readily covering seeds. Therefore, chitosan is a good seed treatment agent.

In the present paper, we report the results of preliminary study on chitosan being used as a seed treatment agent for cotton and maize.

2 Materials and methods

The commercial chitosan was isolated from crab shell which was dissolved in 0.5% hydrochloric acid and the solution was adjusted to pH 6 with 1 mol/L sodium hydroxide solution. The cotton seed was soaked with a 0.1% chitosan solution for 24h and the maize seed was dressing with a 1% chitosan solution respectively.

The tests were conducted in the field of Zhou Village and Xu Village, Liaocheng of Shandong Province. The cotton seed was treated with chitosan and was sowed in

three test plots, the area of each plot was $17.7 \times 100\text{m}^2$. Another three plots of the same area were used for the control. The maize seed was treated with chitosan and was sowed in three test plots, the area of each plot was $35.5 \times 100\text{m}^2$. Another three plots of the same area for the control.

The percent and degree of plant disease were examined, when cotton and maize were infected, the symptom of disease was separated with four grades.

3 Results and discussion

3.1 Effect of prevention disease by chitosan for cotton and maize

The chitosan has played a active role to restrain against a lot of plant pathogenic bacteria (Allan, 1979). In our tests of cotton and maize were also observed the phenomenon. Data listed in Table 1 show that the percentage and degree of cotton seedling stage disease as well as wilt and yellow wilt were lower than that of control. The percent of seedling stage disease was 2.05 and 6.67 in test plots of Xu Village and Zhou Village, respectively, but that was 4.20 and 20.17 in control.

Table 1 Effects of soaking of cotton seed with 0.1% chitosan solution on plant disease pests

	Group	Repeat	Seedling stage diseases morbidity, %	Yellow wilt morbidity, %	Verticillium wilt morbidity, %
Xu Village	Control	1	6.38	4.17	3.09
		2	2.04	4.17	3.09
		3	4.17	4.17	2.04
		Average	4.20	4.17	2.74
	Chitosan	1	3.09	0	1.01
		2	1.01	0.02	0
		3	2.04	1.01	1.01
		Average	2.05	0.34	0.67
Zhou Village	Control	1	29.87	0	4.17
		2	21.95	0	1.01
		3	8.70	0	0
		Average	20.17	0	1.73
	Chitosan	1	13.64	2.04	1.01
		2	6.38	0	0
		3	0	1.01	1.01
		Average	6.67	1.02	0.67

Hadwiger *et al.* (Hadwiger, 1984) reported that chitosan contained no ability of inhibition the virulent pathogen for plant seeds of hard or thick skin. While the previous results indicated that chitosan really showed the ability for cotton seed.

Table 2 shows that seed dressing of maize with a 1% chitosan solution inhibit smut morbidity. These experimental results indicated that chitosan has the restrained effect against maize smut and smut was not observed in chitosan plots.

Table 2 Effects of seed dressing of maize with a 1% chitosan solution on maize smut morbidity (%)

	Xu Village	Zhou Village
Control	0.2	0.45
Chitosan	0	0

3.2 Effectiveness of increasing yield of cotton and maize with chitosan

The cotton seed soaked with a 0.1% chitosan solution sprouted one day earlier than control group. The data listed in Table 3 indicate the rate of emergence by 13.7% over control and cotton increase yield by 11.8% over control. The shedding of cotton bolls of test group was 10% less than control group.

Table 3 Effect of chitosan seed treatment on cotton yield in Xu Village

Group	Repeat	Rate of emergence, %	Average yield, kg/100m ²	Increase yield, kg/100m ²	Increase over control, %
Control	1	83	9.38		
	2	80	9.0		
	3	80	9.35		
	Average	81	9.24		
Chitosan	1	96	10.43		
	2	98	10.29		
	3	90	10.26		
	Average	94.7	10.33	1.09	11.80

The data in Table 4 indicate the effect of chitosan seed treatment on maize yield. The maize yield of Zhou Village was less than Xu Village since waterlogging.

Table 4 Effect of chitosan seed treatment on maize yield

	Group	Average yield, kg/100m ²	Increase yield, kg/100m ²	Increase over control, %
Xu Village	Control	70.56		
	Chitosan	84.96	14.40	20.40
Zhou Village	Control	45.20		
	Chitosan	51.60	6.40	14.20

In the tests of summer maize carried on the fields of Shunyi County of Beijing, we find that the growth period of summer maize reduced from 100 d to 93 d. It is consequently a good matter for doing farm work in the right season.

These results indicate that chitosan is a good seed treatment agent of cotton and maize.

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