

Research of Huangguogan anthracnose infection time and optimum control period

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Abstract. This paper studies the Huangguogan anthracnose infected time and different concentration of 25% Pyraclostrobin EC (1500, 2000, 2500 times) in Huangguogan in different periods (before flowering, after flowering, young fruit period, fruit rapid growth period) control effect on Huangguogan anthracnose after application. The results showed that the best control effect on anthracnose of Huangguogan was after anthesis. Among them, the control effect of 2000 times 25% Pyraclostrobin EC was the best, and the control effect reached 53%. However, the control effect of 2500 times 25% Pyraclostrobin EC before flowering was the worst only 21.4%. Therefore, through the comprehensive analysis of field control results obtained after flowering for the prevention and treatment of Huangguogan anthracnose period is the optimum control period. Huangguogan anthracnose infected time during after flowering to fruit period.

1. Introduction

Citrus belong to the Rutaceae family and Citrinae [1]. It started about 30 million years ago [2]. Huangguogan is a unique and resource-rich orange and orange natural hybrids in Sichuan [3]. It is a kind of new variety with independent intellectual property rights in Sichuan province. It has many advantages, like late maturing, special high yield, non-nuclear, sweet and sour moderate, etc [4]. Anthracnose is a fungal disease that causes bacteria to spread by wind, rain and dew. It is easy to disease when high temperature and high humidity, less spring, summer and autumn as much [5]. Through observations and experiments revealed that a large number of Huangguogan in Shimian county were infected with one kind of pathogenic bacteria, *C. gloeosporioides*. The amount of latent infection before the fruit harvest and post-harvest disease severity are closely linked [6]. Citrus anthracnose can lurk on citrus flowers and the surface of fruits [7]. However, it remains unclear whether the fruit has been lured and harmed other parts before fruit development.

2. Materials and Methods

Experimental Location, Plants and Reagents. The trial was conducted at Anshun field, Shimian county, Sichuan province. The experimental plants were 7 years old, tree crown diameter of the same, perennial infected with anthracnose Huangguogan trees. Among them, 12 trees treated with water was used as control and the observation of the beginning period of infection. There were 36 tree species that were treated with potion. The experimental plants were 25% Pyraclostrobin (EC) 1500 times, 25% Pyraclostrobin (EC) 2000 times, 25% Pyraclostrobin (EC) 2500 times.

Experimental Treatment. The 12 observation trees were observed from the early flowering stage. Observation of early flowering were shoots, leaves; Flowering observed objects were shoots, leaves, flowers (stigma); Observations of young fruit objects were branches, leaves, fruits; The rapid growth of fruit observed objects were leaves, branches, fruits. In the observation process recorded the observation time, the affected part and its disease characteristics. Spraying experimental drugs were spent in the pre-flowering, post-flowering, young fruit, fruit rapid growth period.

Experimental treatment used randomized block design. Single plant was a district. Experiment set 3 concentration treatment. Each treatment set 3 repetitions. Experimental set water as a control. The experiment was administered once per period with tree crown spray method.

Control Effect Determination. Each tree was divided into four directions: east, south, west and north. Each position was randomly surveyed from inside the hall and outside. Each position was randomly surveyed from inside the hall and outside. The experiment selected 100 fruits to calculate the disease index and the control effect. Efficacy calculation method refer with: Eq.1, Eq.2.

$$\text{Disease index} = \frac{\sum (\text{Number of diseased fruit} * \text{Number of representatives at that level})}{\text{Total number of fruits surveyed} * \text{The highest representation of disease}} * 100\% \quad (1)$$

$$\text{Relative control effect} = \frac{\text{Control disease index} - \text{Treatment index}}{\text{Control disease index}} * 100\% \quad (2)$$

Citrus peel lesions classification method is formulated as follows (0 belongs to the normal fruit):

0 level: no disease;

1 level: Small spots and spots should not be analyzed. The lesion area occupies less than 5% of the whole fruit area;

3 level: Lesions easy to identify. It has affected the commerciality of the fruit. The lesion area occupies 5% to 10% of the whole fruit area;

5 level: The lesion area occupies 11% to 25% of the whole fruit area. It has obviously affected the commerciality of the fruit;

7 level: The lesion area occupies 26% to 50% of the whole fruit area. It seriously affects the commerciality of the fruit;

9 level: The lesion area occupies more than 50% of the whole fruit area. Fruit product completely declined.

3. Results and Analysis

Infection Period Investigation. Table 1 shows that anthracnose infection of the Huangguogan period is in the young fruit period. It infects during flowering to young fruit period. Infected characteristics first manifested in the Huangguogan leaves.

Table 1 anthracnose infection time survey

Observation period	Observation site	feature	Observation date
pre-flowering	Leaf	No abnormality	2016.3.22
	Branches	No abnormality	2016.3.22
Flowering period	Leaf	No abnormality	2016.4.6
	Branches	No abnormality	2016.4.6
	flower	No abnormality	2016.4.6
young fruit period	Leaf	Withered dehydration, curly shape	2016.4.26
	Branches	No abnormality	2016.4.26
	fruit	No abnormality	2016.4.26
fruit rapid growth period	Leaf	Edges or near the edges appear brown spots, or was curly shape	2016.5.10
	Branches	No abnormality	2016.5.10
	fruit	Dark green spots, depressions appear	2016.5.10

Control Effect. Table 2 shows that pre-flowering, post-flowering, young fruit and fruit rapid growth period were applied 25% EC 1500 times, 2000 times, 2500 times for Huangguogan anthracnose had a certain control effect. As the interaction between the control period and the treatment concentration had no significant effect on the control effect. Therefore, the application period and the drug concentration were analyzed.

Table 2 Huangguogan anthracnose prevention and control statistics

Drug spraying period	1500 times	2000 times	2500 times
pre-flowering	39.2	47.8	21.7
	21.7	47.8	13.1
	21.7	21.7	29.2
post-flowering	58.2	58.2	37.3
	53.0	47.8	36.6
	36.6	53.0	40.2
young fruit period	21.7	47.8	47.8
	30.3	39.2	21.7
	25.8	47.8	30.3
fruit rapid growth period	32.1	39.2	37.3
	25.3	30.3	16.4
	13.1	21.7	21.7

Effects of Anthracnose in Huangguogan during Different Pharmaceutics Treatment. Table 3 shows that applying 25% EC reagent in four periods all had some control effect on anthracnose of Huangguogan. The effect of pesticides in the post-flowering was the best, reaching 46.8%. The effect of pesticides in the rapid growing period of fruits was the worst, reaching only 26.7%.

Table 3 different periods of drug treatment on the prevention and treatment of Huangguogan anthrax

time	Disease index	Control effect (%)
pre-flowering	27.1 b	29.3 b
post-flowering	20.4 c	46.8 a
young fruit period	25.0 bc	35.3 b
fruit rapid growth period	28.2 b	26.7 b
CK	38.3 a	---

Note: Lowercase letters indicate significant differences between treatments ($P < 0.05$), the same below.

Effect of Different Concentrations of 25% EC on Anthracnose Control of Huangguogan. Table 4 shows that 25% EC for the prevention and treatment of Huangguogan anthrax had a certain effect. It was best to control the anthracnose of Huangguogan by 25% EC2000, reaching 41.9%. The liquid control effect of the 25% EC 1500 times and 2500 times was less than the control effect of the 2000 times which difference is not obvious. The results showed that 25% EC in this experiment for anthracnose prevention and treatment of Huangguogan optimum concentration was about 2000 times.

Table 4 different concentrations of 25% EC on the prevention and treatment of Huangguogan anthrax

Processing concentration	Disease index	Control effect (%)
25% Pyraclostrobin (EC)1500	26.2 b	31.5 b
25% Pyraclostrobin (EC)2000	22.2 c	41.9 a
25% Pyraclostrobin (EC)2500	27.0 b	29.4 b
CK	38.3 a	---

4. Summary

The results of this experiment show that there was no surface feature of anthracnose infestation before flowering and flowering period of Huangguogan. Huangguogan anthrax infection period was the beginning of young fruit period. Infestation begins after floescence until young fruit period. This is similar to the conclusion drawn by S.X. Liu [9] on the effect of bagging on anthracnose disease of apple blight in Fuji apple. After flowering was the prevention and treatment of Huangguogan anthrax suitable period. This is similar to the results of Li Xuebin [10] in the research on the occurrence and control of citrus anthracnose. Conclusions were drawn from the control efficacy of three different concentrations of 25% Pyraclostrobin (EC) used in the experiment. The

best control effect of Huangguogan is to use 25% Pyraclostrobin (EC) 2000 times after flowering.

Citrus anthracnose prevention and control strategies should be based on prevention. If the onset of symptoms appeared after the application of pesticide control effect is not ideal. So, after flowering timely chemical control can significantly reduce the risk of anthrac infection.

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