

オキシテトラサイクリンの注入によるスモモ葉焼病(仮称)の 発病抑制

誌名	日本植物病理學會報 = Annals of the Phytopathological Society of Japan
ISSN	00319473
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発行元	日本植物病理學會
巻/号	53巻3号
巻号補足	
掲載ページ	p. 354-359
発行年月	1987年7月

農林水産省 農林水産技術会議事務局筑波産学連携支援センター
Tsukuba Business-Academia Cooperation Support Center, Agriculture, Forestry and Fisheries Research Council
Secretariat



Suppression of Leaf Scald Symptom in Plum by Oxytetracycline Injection*

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Abstract

Oxytetracycline (OTC) suppressed leaf scald symptoms in plum following trunk injection. Tools required were a cordless drill, a 28/163 cm drill bit, a hammer and J. J. Mauget's OTC capsules. Two injection schedules, one in late April or early May and the other in mid October, were selected for the best effect. Two capsules, each containing 0.16 g of OTC in 4 ml solution were injected into each tree each time and two capsules of carrier solution were injected in control trees. After the first, third, and fifth injection in April, 1984, May, 1985 and May, 1986, respectively, OTC caused 61.5-100%, 73.3-100%, and 76.9-100% symptoms suppression recorded in August, 1984, 1985, and 1986, respectively. In May, 1985, after the second injection was administered in October, 1984, treated trees showed much less twig dieback than control trees.

(Received January 29, 1987)

Key words : phony peach, oxytetracycline chemotherapy.

Introduction

Plum leaf scald (PLS) is a disease caused by a xylem-limited bacterium. The disease was first described in 1935 in Argentina⁷⁾. In the United States, PLS was reported in 1977⁴⁾ and caused a serious problem on plums in the Southeastern area. In 1981, the bacterium was independently isolated and cultured in cell-free medium by Davis *et al.*³⁾ and Wells *et al.*¹²⁾. *In vitro*, the bacterium has shown to be very susceptible to penicillin and tetracycline. The minimum inhibitory concentrations of the above two antibiotics were 6.25 µg/ml and 1.56 µg/ml, respectively¹⁾. *In vivo*, however, no chemical control method has been studied and recommended for the growers. The disease causes tremendous losses in the plum industry. Besides, the same bacterium can cause phony disease of peach¹³⁾. An effective chemical control of the plum leaf scald disease not only may help the plum industry, but may reduce the phony peach incidence. We report herein the effective suppression of leaf scald symptoms in plum by oxytetracycline injection.

* Supported in part by the U. S. Hatch and Georgia State Funds.

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Materials and Methods

Diseased trees. A total of nine 7-year old plum trees (*Prunus salicina* L.) showing leaf scald symptoms for the past three years located at Byron, GA were selected for injection. Randomly selected, six trees were injected with oxytetracycline and three with carrier as controls. The average trunk circumference was 35 cm, ranging from 31.2 to 40.1 cm.

Oxytetracycline (OTC) and tree injection. Oxytetracycline capsules manufactured by J. J. Mauget Co. of Fairbank, CA were used. Each capsule contained 0.16 g of OTC in 4 ml solution. Holes (28/163 cm) were drilled into trees with a cordless drill (Black & Decker) about 10–15 cm above the ground. The hole depths varied among the trees. Generally, the drill was stopped when the white, living xylem tissue debris was seen in the drill bit. A tube was then inserted into the hole and a pressurized capsule containing OTC or carrier was then punctured into the tube by a hammer. Two capsules, for a total of 0.32 g OTC, were injected into each treated tree using one capsule in each side. Two capsules of the carrier solution were injected into each control tree. The capsules were disconnected and the uptake of the solutions were recorded 24 hrs after injection. Injections were applied to each tree on the following dates: 27 April, 1984, 12 October, 1984, 10 May, 1985, 30 September, 1985, and 13 May, 1986.

Suppression of scald symptom. In August of 1984, 1985, and 1986, the efficacy of the OTC for suppression of scald symptom in plums was recorded by counting the total numbers of branches showing no leaf scald symptom. These numbers were then used to measure the percent suppression.

Results

Uptake of the oxytetracycline

Two to several hours were required for a tree to absorb 4 ml of solution. Capsules were disconnected 24 hr after injection, or otherwise as indicated. The uptake rates were almost 100%, except one was 75% and the other 50%.

Toxicity of oxytetracycline to plum trees

Two trees in our first injection developed a burning effect on part of the tree by OTC. The burning effect was described as the color of the branches including twigs and leaves turned black after the OTC injection. No toxicity effect of OTC was recorded in the other four injections.

Suppression of leaf scald symptoms

It was evident that oxytetracycline effectively suppressed the symptom development (Table 1). The treated trees exhibited 61.5–100%, 73.3–100%, and 76.9–100% symptom suppression after one, three, and five injections, respectively, whereas no suppression at all was shown in the control trees. On August 2, 1984, the control trees were turning brown and dying, whereas the treated trees were a healthy green color. The sup-

Table 1. Percent suppression of leaf scald symptom in plum by oxytetracycline injection over a period of three years

Tree #	Tetracycline (T) or Control (C)	Number of branches per tree	Percent suppression (%) ^a		
			1984	1985	1986
23	T	15	66.7	73.3	80
24	T	13	92.3	92.3	92.3
26	C	10	— ^{b)}	—	—
27	T	4 ^{c)}	100	100	100
28	T	13	61.5	76.9	76.9
29	C	7	0	0	0
30	T	8 ^{d)}	75.0	75	100
31	T	9	100	100	100
32	C	6	0	0	0

a) Percent suppression = number of branches showing no leaf scald symptom divided by numbers of total branches.

b) Tree #26 developed early defoliation and more red leaves without apparent scald symptom

c) Tree #27, 3/4 (75%) branches were burned due to toxicity.

d) Tree #30, 4/8 (50%) branches were burned due to toxicity.

pressive effect of OTC after two injections is shown in Fig. 1A & B, where the treated trees showed less dieback compared with the control trees.

Discussion

For the first time we have demonstrated from a field study that oxytetracycline is able to suppress the leaf scald symptoms through tree injection. Two capsules containing 0.32 g of OTC in 8 ml solution are enough for 61.5–100% suppression in treated trees. The symptom suppression rates increased as the injection times increased (Table 1). Tools required for injection are a cordless drill (Black & Decker), an 28/163 cm drill bit and a hammer in addition to the J. J. Mauget's OTC capsules. Whether it is economically applicable has not been analyzed.

In vitro, tetracycline is very inhibitory to the growth of several plant pathogenic XLB¹⁾. Among twelve antibiotics tested, tetracycline was the most potent in inhibition of XLB growth. The minimum inhibitory concentration (MIC) of tetracycline to plum leaf scald bacterium was 1.56 µg/ml, whereas that of penicillin, chloramphenicol, erythromycin and ampicillin was 6.25, 3.13, 6.25, and 12.5 µg/ml, respectively. Symptom suppression results obtained from *in vivo* tests demonstrate the efficacy of tetracycline for potential application for control of plant diseases caused by XLB.

Tetracycline has been used for the symptom suppression of grape vines that exhibited Pierce's disease symptoms⁵⁾ and for many other diseases caused by mycoplasma-like organisms^{6,9,10)}. Hopkins and Mortensen⁵⁾ treated eight-year-old grapevines by soil drenching with 8 liters of a 50 µg/ml tetracycline solution twice-weekly for about 4 months. The remission of existing symptoms started approximately 40 days after the



Fig. 1. Control tree (A) showing extensive twig dieback contrasted with oxytetracycline-treated tree (B) showing much less twig dieback, 10 May 1985.

first drenching, which amounted to about 4.8 g of tetracycline that was applied. This is 15-fold more tetracycline than the 0.32 g used to inject each plum tree. Also, only

two injections per year were required for symptom suppression as compared to twice-weekly for a period of 4 months by soil drenching.

Two injection times, one in late April/early May and the other in late September/early October, were selected in order to obtain the best effect. Plum leaves are fully expanded and most physiologically active in late April/early May when the best uptake of the solution is expected. The bacterial population, according to our previous study, is at its lowest in April and May²⁾. Therefore, we would be able to apply the minimum amount of OTC to diminish the number of bacteria. No other injection is needed until after harvest in October. The residue of OTC in plant tissue two to three months after injection is usually nondetectable^{8,11)}. For example, in the determination of OTC level in 482 coconut fruits, McCoy⁸⁾ reported only 5 had detectable levels of OTC in coconut milk, all less than 0.3 µg/ml. Nineteen had trace amounts of OTC (<0.2 µg/ml) in milk. All other coconut milk readings were zero. Of 202 coconuts from which meat samples were assayed, 25 had measurable OTC levels, most of them less than 1.0 µg/g, although one did contain 2.6 µg/g of meat. Twenty had less than 0.3 µg/g in meat, 150 had not activity in the meat. The persistence values of OTC in coconut foliage indicate a half-life of about 2 weeks⁹⁾. The half-life of OTC-HCl in aster is about 3-4 days as reported by Sinha and Peterson¹¹⁾. The contamination of OTC in fruit would not be a problem for the consumers. The October injection, performed after harvest, was intended to reduce the number of bacterium that survived the April or May injection.

The tree injection technique developed by J. J. Mauget Co. is easy and effective. The tree injection has the advantage of eliminating air pollution generally caused by spraying. With the high uptake rate and safe and simple application technique, we believe it can be used for other tree treatment, such as systemic pesticides which are now applied by tree spraying.

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和 文 摘 要

C. J. CHANG・C. E. YONCE・D. GARDNER: オキシテトラサイクリンの注入によるスモモ葉焼病(仮称)の

発病抑制

スモモの葉焼病はオキシテトラサイクリン (OTC) の樹幹注入により抑制された。作業にはコード無ドリル, 28/163 cm ドリル刃, 金ヅチおよび OTC カプセルを必要とした。4月下旬又は5月上旬に1回目, 10月中旬に2回目の注入が最も効果的であった。それぞれ 0.16 g の OTC を含む 4 ml の溶液の入ったカプセル2個分を各時期に各樹に注入し, 対照樹にはキャリア液のみをそれぞれ注入した。1984年4月, 1985年5月および1986年5月にそれぞれ1回目, 3回目および5回目の注入を行ない, 1984, 1985および1986年の各8月に調査した結果, OTC による発病抑制はそれぞれ61.5-100%, 73.3-100%および76.9-100%であった。1984年10月に2回目の注入を行なった樹では翌年5月には対照樹に比べて小枝の枯死が格段に少なかった。