

Fusarium moniliforme var. subglutinansの鹿児島県における分布とマツ類に対する病原性

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論 文

Distribution of *Fusarium moniliforme* var. *subglutinans* in Kagoshima Prefecture and Its Pathogenicity to Pines

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MURAMOTO, Masahiro, TASHIRO, Takashi and MINAMIHASHI, Hitoshi: **Distribution of *Fusarium moniliforme* var. *subglutinans* in Kagoshima Prefecture and its pathogenicity to pines.** J. Jpn. For. Soc. 75: 1~9, 1993 The distribution of *Fusarium moniliforme* SHELTON var. *subglutinans* WOLLENW. et REINKING was investigated by means of the bark-washing method, the spore-trapping from the air, and isolation from Ryukyu pine (*Pinus luchuensis* MAYR) and sugar cane (*Saccharum officinarum* L.) tissues. *F. subglutinans* has been found in Tatsugo-cho, Kasari-cho, and Nase-shi on Amamioshima Island and Kamo-cho, Kedoin-cho, Tsuruta-cho, Hishikari-cho, and Kirishima-cho in southern mainland Kyushu. The colony numbers of *F. subglutinans* detected differed remarkably between investigation years. No conidium of *F. subglutinans* have been detected in the air in southern Kyushu. More colonies have been detected in needles than in stems and branches of healthy pines. It also has been isolated from sugar cane on Amamioshima Island. Those isolates from Ryukyu pine in Tatsugo-cho had severe pathogenicity against *Pinus* spp. They caused damping off of Ryukyu, Virginia (*P. virginiana* MILL.), and Monterey (*P. radiata* D. DON) pine seedlings, twig blight of Ryukyu and slash (*P. elliottii* ENGELM. var. *elliottii*) pines and stem canker of Ryukyu and Japanese black (*P. thunbergii* PARL.) pines. Isolates from Japanese red pine (*P. densiflora* SIEB. et ZUCC.) in Kirishima-cho killed branches of Ryukyu pine.

村本正博・田代 卓・南橋 仁：*Fusarium moniliforme* var. *subglutinans* の鹿児島県における分布とマツ類に対する病原性 日林誌 75: 1~9, 1993 *Fusarium moniliforme* SHELTON var. *subglutinans* WOLLENW. et REINKINGの分布を7種のマツの樹皮洗浄法、空中からの孢子捕捉試験、リュウキュウマツとサトウキビからの分離によって調査した。*F. subglutinans* は奄美大島の竜郷町、笠利町、名瀬市、南部九州の蒲生町、祁答院町、鶴田町、菱刈町、霧島町で採取された。樹皮洗浄法で検出された *F. subglutinans* コロニーの数は調査年により大きく変異した。南部九州では *F. subglutinans* を空中から検出できなかった。健全なマツにおいて、*F. subglutinans* は幹、枝よりも針葉でよく検出された。*F. subglutinans* はサトウキビ組織からも分離された。竜郷町のリュウキュウマツから分離した *F. subglutinans* は数種のマツに病原性を示した。すなわち、リュウキュウマツ、バージニアマツ、ラジアタマツの実生苗木には全身枯れを起こし、リュウキュウマツ、スラッシュマツの枝を枯死させ、リュウキュウマツとクロマツの幹に胴枯れを形成した。霧島町のアカマツから分離した *F. subglutinans* はリュウキュウマツの枝を枯死させた。

I. Introduction

Pitch canker is a major disease of planted pines in the southern United States (BLAKESLEE *et al.*, 1980). In Japan, MURAMOTO *et al.* (1988) reported this disease on Ryukyu pine (*Pinus luchuensis* MAYR). This disease is distributed on Amamioshima Island, Kagoshima Prefecture and on Okinawa Ishigaki, Iriomote, Kume, Miyako Islands, Okinawa Prefecture (KOBAYASHI and MURAMOTO, 1989; KOBAYASHI and KAWABE, 1991).

The causal agent of pitch canker of Ryukyu pine is *Fusarium moniliforme* SHELTON var. *subglutinans* WOLLENW. et REINKING (KOBAYASHI and MURAMOTO, 1989). It was reported that isolates from Ryukyu pine in Tatsugo-cho, Amamioshima Island, Kyushu had pathogenicity to Ryukyu pine, Japanese black pine (*P.*

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thunbergii PARL.), and Japanese red pine (*P. densiflora* SIEB. et ZUCC.) (KOBAYASHI and MURAMOTO, 1989). However, no primary infection source, dispersal season of conidia, and the vector of the pathogen in Japan have been known.

Pine pitch canker was called a disease complex in the United States because the occurrence of this disease is related to various factors (DWINELL *et al.*, 1985). This paper reports the distribution of *F. subglutinans* in Kagoshima Prefecture, Kyushu, and the results of inoculation experiments with cultured *F. subglutinans* on pines.

II. Materials and Methods

1. Medium for isolation

Demosan-PCNB-streptomycin (DPS) medium was used for the isolation of *F. subglutinans*. The following agents were used for the preparation of 500 ml of medium: deionized water (250 ml), potato broth (250 ml), dextrose (10 g), chloroneb (demosan) (0.5 g), PCNB (0.5 g), streptomycin sulfate (0.3 g), neomycin sulfate (0.06 g), and agar (10 g).

2. Medium for identification

Carnation leaf agar (CLA) medium was used for the identification of *F. subglutinans* (NELSON *et al.*, 1983).

3. Isolation method

1) The bark-washing method

This method was invented by DWINELL, plant pathologist of Southeastern Forest Experiment Station, USDA, Forest Service in 1989. We adapted this method one time per one pine tree. Numbers of pine trees per one pine stand were selected at random. About 200 cm² of a stem surface was selected as the washing area. About 10 ml of distilled water was sprayed on the stem surface, and then about 5 ml of water was collected into test tubes through funnels with an edge cut into a crescent shape. One milliliter of the above described water was collected from one pine tree and was immediately sprayed on a DPS plate. The DPS plates were cultured at 23 °C for 10 days, and *F. subglutinans* colonies were counted.

2) The rinsing method

Four small branches were cut from a healthy pine tree. Ten gram of pine needles were plucked off from each branch and were cut into 2 cm long pieces. These were rinsed for one minute in a 200 ml beaker containing 100 ml distilled water. The rinse water was sprayed onto a DPS plate as described in the bark-washing method. Twenty grams of a small branch without needles was into 2 cm long pieces which were rinsed with 50 ml of distilled water. The rinse water was sprayed onto a DPS plate.

3) Spore-trapping test from the air

Lidless DPS plates were put on the ground or were hung from a branch of a pine tree. Twelve to sixty DPS plates were left for a definite time to trap spores from the air. Start and finish times of the experiment were recorded. Weather and wind conditions also were recorded. DPS plates were cultured at 23 °C for 10 days and, *F. subglutinans* colonies were counted.

4) Isolation of *F. subglutinans* from the stem tissues of Ryukyu pine

The purpose of this experiment was to detect the pathogen on Ryukyu pine at new damage sites. Two Ryukyu pines from Nase-shi Kasari-cho were used as sample trees. Small pieces, 2.5 mm long, from wood with bark of Ryukyu pine were used for isolation. Fifty sample pieces were taken from each Ryukyu pine. These samples were rinsed in 80 % ethylalcohol for 30 sec, and they were sterilized in 0.1 % mercuric chloride for three minutes, and finally they were rinsed in sterilized water for 30 sec. The stem pieces were put on DPS medium plates, and these plates were kept in an incubator at 23 °C in darkness for 10 days.

5) Isolation of *F. subglutinans* from sugar cane

Two samples of sugar cane (*Saccharum officinarum* L.) showing leaf blight were taken at the Oshima branch of the Kagoshima Agricultural Experiment Station. Fifty small pieces, each 25 mm long, were taken from the leaves. Samples were treated in the same way as was Ryukyu pine described previously.

4. Identification of isolates

Isolates obtained by isolation tests were transplanted to CLA slants to confirm whether it was *F. subglutinans* or not. The identification was made by microscopic observations of macroconidia and polyphialide.

5. Inoculation tests

1) Inoculations of seedlings

Two-year-old Ryukyu, Virginia (*P. virginiana* MILL.) and loblolly (*P. taeda* L.) pine seedlings were used for the inoculations. The numbers of inoculated trees were 92 Ryukyu pines, 6 Virginia pines, and 6 loblolly pines. Tests on Ryukyu pine were done in the nursery of the Tatsugo Branch, Kagoshima Prefectural Forest Experiment Station. Tests on the Virginia and loblolly pines were made in the greenhouse of University of Georgia, Athens, Georgia, United States. Mycelia of *F. subglutinans* were cultured for two weeks on DPS plates used as inoculum. The seedlings were inoculated by making a small slit on new shoots with a needle and placing a small amount of mycelia into the slit. On control seedlings, only a small slit was made without applying mycelia.

2) Inoculation of small branches

New shoots of branches of 11~19-year-old Ryukyu pine and 25-year-old slash pine (*P. elliottii* ENGELM. var. *elliottii*) were inoculated in the same way as the seedlings.

3) Stem inoculations

(1) Inoculation with mycelia

Six- to seven-year-old Ryukyu pines were used as test trees. A fine cut, 1 cm long by a knife, was made to the surface of Ryukyu pine stems. A small quantity of mycelia of *F. subglutinans* were inoculated onto the cut. The cut was covered with 2 cm squares of a cotton and a gauze.

The gauze was fixed with a vinyl tape and a staple. Two milliliters of sterilized water was injected into the gauze.

(2) Inoculation with conidia

Spore suspensions (10^6 conidia/ml) of *F. subglutinans* used as inoculum to the stems of 15~25-year-old Ryukyu pine and Japanese black pine. Bark, 2 cm $\times$ 2 cm, was cut by a knife. After spraying 70 % ethylalcohol on the wound, a spore suspension was applied to it.

4) Observations of symptom development

In the cases of seedlings and branches, dieback of the upper parts of the inoculation points, resin flows and pitch soaking into the wood were observed two months after inoculations. In stems, the lengths and widths of cankers were measured six months after inoculations.

III. Results and Discussion

The *Fusarium* species isolated in this study formed characteristic macroconidia and polyphialide (Figs. 1 and 2). According to NELSON'S description, all of these isolates were identified as *Fusarium moniliforme* var. *subglutinans*.

On Kyushu Island, *F. subglutinans* was isolated in Kamo-cho, Kedoin-cho, Tsuruta-cho, Hishikari-cho, and Kirishima-cho by bark-washing method (Table 1). In Kamo-cho, no *F. subglutinans* had been detected in June, 1990. However, on the same test plot, we could detect it in May and June, 1991. Although the experiment was done only once, no *F. subglutinans* had been detected in Yamagawa-cho, Kaimon-cho, Kiire-cho, Ibusuki-shi, Kagoshima-shi, Kurino-cho, Kokubu-shi, Fukuyama-cho, Tarumizu-shi, Kanoya-shi, Uchinoura-cho, and Koyama-cho. On Amamioshima Island, it was isolated in Tatsugo-cho. On December 3, 1990, we made isolation tests by the bark-washing method in three areas on Amamioshima Island, R(20), R(21), and R(22). As shown in Table 1, *F. subglutinans* was detected only on R(21) of Tatsugo-cho.

Table 2 shows the results of isolation tests of *F. subglutinans* taken from healthy pines by the rinsing method. The density of *F. subglutinans* was greater in pine needles than in branches and stems. It seems that the *F. subglutinans* conidia in bundles of pine needles were protected from glaring sunlight.

Table 3 shows results of trapping test from the air of *F. subglutinans*. On Amamioshima Island, *F.*



Fig. 1. Macroconidia and microconidia of *Fusarium moniliforme* var. *subglutinans*

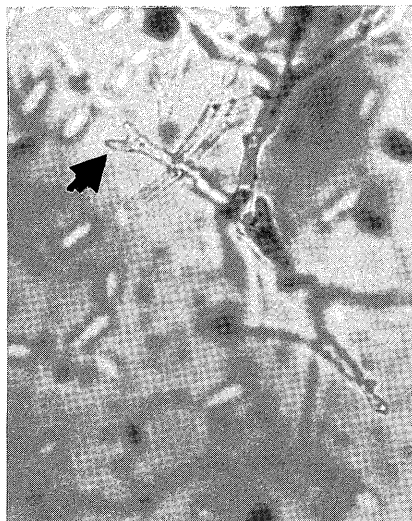


Fig. 2. Polyphialide of *Fusarium moniliforme* var. *subglutinans*

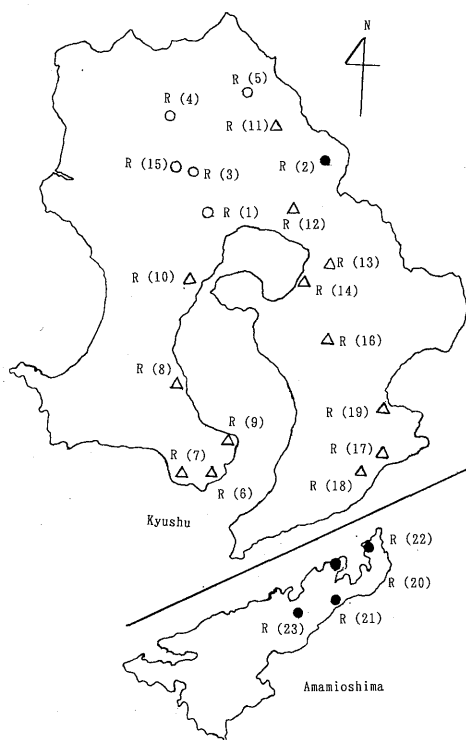


Fig. 3. Distribution of *Fusarium moniliforme* var. *subglutinans*

F. subglutinans: ●, Pathogenicity was confirmed; ○, Detected, pathogenicity was not clear; △, Not detected.



Fig. 4. Resin flow and canker on Japanese black pine inoculated with *Fusarium moniliforme* var. *subglutinans*

Table 1. Results of *F. subglutinans* isolation tests by the bark-washing methods

Area codes	Sites of stands	Pine species	Dates of isolations	Numbers of DPS plates	Mean numbers of colonies per plate
R (1)	Kamo	<i>P. armandii</i> FRANCH.	June 14, 1990	1	0
		<i>P. densiflora</i>	June 14, 1990	1	0
		<i>P. elliotii</i> var. <i>elliotii</i>	June 14, 1990	4	0
		<i>P. luchuensis</i>	June 14, 1990	3	0
		<i>P. palustris</i> MILL.	June 14, 1990	2	0
		<i>P. teada</i>	June 14, 1990	3	0
		<i>P. thunbergii</i>	June 14, 1990	7	0
		<i>P. armandii</i>	May 6, 1991	1	1
		<i>P. densiflora</i>	May 6, 1991	1	1
		<i>P. elliotii</i> var. <i>elliotii</i>	May 6, 1991	3	2.3
		<i>P. luchuensis</i>	May 6, 1991	1	1
		<i>P. palustris</i>	May 6, 1991	4	1
		<i>P. teada</i>	May 6, 1991	3	0
		<i>P. thunbergii</i>	May 6, 1991	5	2.6
		<i>P. armandii</i>	June 18, 1991	1	22
		<i>P. densiflora</i>	June 18, 1991	1	0
		<i>P. elliotii</i> var. <i>elliotii</i>	June 18, 1991	5	69.6
		<i>P. palustris</i>	June 18, 1991	5	32.8
		<i>P. teada</i>	June 18, 1991	5	28.0
		<i>P. thunbergii</i>	June 18, 1991	5	28.8
R (2)	Kirishima	<i>P. densiflora</i>	April 15, 1991	18	1.2
R (3)	Kedoinn	<i>P. teada</i>	April 22, 1991	10	0.4
R (4)	Tsuruta		April 22, 1991	10	0.1
R (5)	Hishikari		April 22, 1991	8	0.3
R (6)	Yamagawa	<i>P. thunbergii</i>	May 1, 1991	12	0
R (7)	Kaimonn		May 1, 1991	12	0
R (8)	Kiire		May 1, 1991	12	0
R (9)	Ibusuki		May 1, 1991	12	0
R (10)	Kagoshima		May 1, 1991	10	0
R (11)	Kurino	<i>P. densiflora</i>	May 28, 1991	40	0
R (12)	Kokubu	<i>P. thunbergii</i>	July 16, 1991	4	0
R (13)	Fukuyama		June 16, 1991	3	0
R (14)	Tarumizu		June 16, 1991	8	0
R (15)	Kamo	<i>P. palustris</i>	June 16, 1991	6	0
R (16)	Kanoya	<i>P. thunbergii</i>	June 16, 1991	10	0
R (17)	Uchinoura		June 16, 1991	10	0
R (18)			June 16, 1991	5	0
R (19)	Koyama		June 16, 1991	10	0
R (20)	Tatsugo	<i>P. luchuensis</i>	June 25, 1990	21	10.5
			Sept. 17, 1990	12	1.6
			Dec. 3, 1990	7	0
			May 13, 1991	10	111.7
R (21)	Tatsugo		Dec. 3, 1990	5	1
			May 13, 1991	10	90.8
R (22)	Kasari		Dec. 3, 1990	5	0

Notes: R (1)~R (19) are on Kyushu Island; R (20)~R (22) are on Amamiyoshima Island.

Table 2. Results of *F. subglutinans* isolation tests on pine trees by the rinsing method

Sites of stands	Pine species	Numbers of trees	Parts of isolations	Dates of isolations	Numbers of DPS plates	Mean numbers of colonies
Kamo	<i>P. elliotii</i> var. <i>elliotii</i>	2	Stem	Sept. 2, 1991	8	0
			Branch	Sept. 2, 1991	16	0.1
			Leaf	Sept. 2, 1991	40	0.8
Annkyaba Tatsugo	<i>P. luchuensis</i>	3	Stem	Sept. 24, 1991	24	0
			Branch	Sept. 24, 1991	12	0
			Leaf	Sept. 24, 1991	12	0.3
Oogachi Tatsugo	<i>P. luchuensis</i>	3	Stem	Sept. 25, 1991	24	0
			Branch	Sept. 25, 1991	12	0
			Leaf	Sept. 25, 1991	12	0.5

Note: *F. subglutinans* on stems were collected by bark-washing method.

Table 3. Results of trapping *F. subglutinans* from the air

Area codes	Experiment periods			Weather	Numbers of DPS plates	Mean numbers of colonies per plate
	Years	Start times	Finish times			
R (20)	1990	July 25, a.m. 11	July 26, a.m. 10	Cloudy	40	4.0
R (20)	1990	Sept. 17, a.m. 11	Sept. 17, p.m. 3	Rain	20	0.4
R (22)	1990	Dec. 3, a.m. 9	Dec. 4, a.m. 10	Cloudy	12	0.1
R (20)	1990	Dec. 3, p.m. 2	Dec. 4, a.m. 11	Cloudy	60	0.1
R (21)	1990	Dec. 3, p.m. 2	Dec. 4, a.m. 11	Cloudy	20	0
R (1)	1991	April 19, p.m. 3	April 20, a.m. 11	Cloudy	26	0
R (8)	1991	May 1, a.m. 11	May 2, a.m. 11	Cloudy	20	0
R (20)	1991	May 13, a.m. 11	May 13, p.m. 4	Cloudy	20	0.3
R (20)	1991	May 13, p.m. 4	May 14, p.m. 1	Rain	20	2.7
R (21)	1991	May 13, p.m. 4	May 14, a.m. 10	Rain	20	0
R (1)	1991	June 8, a.m. 9	June 8, p.m. 4	Clear	12	0
R (21)	1991	June 18, a.m. 9	June 18, p.m. 4	Cloudy	20	0
R (21)	1991	June 17, p.m. 5	June 18, a.m. 9	Cloudy	20	0

Note: Code numbers coincides with the numbers in Fig. 1.

Table 4. Results of isolation tests of *F. subglutinans* on the stem tissues of Ryukyu pine

Area codes	Sites of stands	Numbers of sample pieces	Isolation rates (%)
R (22)	Kasari	50	54
R (23)	Nase	50	32

Note: Isolated on March 7, 1989.

Table 5. Results of isolation tests of *F. subglutinans* on sugar cane leaf tissues

Number of sample pieces	Isolation rates (%)		
	<i>F. subglutinans</i>	Bacteria	Not detected
49	44.9	2.0	53.1

Note: Isolated on July 31, 1989 on DPS.

subglutinans was trapped from the air in May, July, September, and December. In Kamo-cho and Kiire-cho, main Kyusyu, no *F. subglutinans* was so trapped. The trapping test from the air on Kyusyu were done only three times. We felt the need to more experiments.

To investigate the natural distribution of *F. subglutinans* conidia, we conducted three experiments, the bark-washing method, the rinsing method, and the trapping test from the air. Finding the primary infection source of this disease is very important for disease control. In the United States, BLAKESLEE *et al.* (1978)

Table 6. Results of isolation tests

Test plots	Pine species	Ages	Inoculation points	Code of fungus	Inocula	Number of pine trees			
						Inoculated	Caused resin flows	Caused die back	Reisolated
Tatsugo	<i>P. luchuensis</i>	18	Branch	TA-1	Mycelium	10	8	0	8
		18		Control		10	0	0	0
		6	Stem	TA-1	Mycelium	11	7	0	7
		6		Control		10	0	0	0
		7	Stem	TA-1	Mycelium	5	5	0	5
		19	Branch	TA-1	Mycelium	6	2	0	2
		19		Control		5	0	0	0
Kamo	<i>P. elliotii</i> var. <i>elliottii</i>	25	Branch	TA-1	Mycelium	5	0	2	2
		25		Control		4	0	0	0
	<i>P. luchuensis</i>	15	Stem	TA-1	Spore	3	3	0	3
		15		Control		1	0	0	0
	<i>P. thunbergii</i>	15	Stem	TA-1	Spore	5	2	0	2
		15		Control		4	0	0	0
Tatsugo	<i>P. luchuensis</i>	11	Branch	TA-1	Mycelium	14	6	2	6
		11		Control		7	0	0	0
		11	Stem	TA-1	Spore	7	4	0	4
		3	Stem	CO-1	Mycelium	7	2	3	5
		3	Stem	TA-1	Mycelium	85	1	57	49
		11	Branch	KI-1	Mycelium	10	0	9	9
		11	Branch	TA-1	Mycelium	10	0	7	7
		11		Control		10	0	0	0
Athens	<i>P. virginiana</i>	2	Stem	TA-1	Mycelium	6	0	6	0
	<i>P. radiata</i>	2	Stem	TA-1	Mycelium	6	0	6	0

Note: Code of fungus: TA-1, *Fusarium moniliforme* var. *subglutinans* isolated from Ryukyu pine in Tatsugo-cho; CO-1, *Fusarium moniliforme* var. *subglutinans* isolated from larva of codling moth in Ryukyu pine in Tatsugo-cho; KI-1, *Fusarium moniliforme* var. *subglutinans* isolated from Japanese red pine by bark-washing method in Kirishima-cho.

Table 7. Dimensions of cankers on inoculated pine stems

Test plots	Pine species	Tree sample numbers	Ages	Date of inoculations	Periods after inoculations (months)	Dimensions of cankers (cm)	
						Lengths	Widths
Tatsugo	<i>P. luchuensis</i>	F477	7	April 30, 1988	6	8.5	3.0
		F479	7	April 30, 1988	6	10.0	2.5
Kamo	<i>P. luchuensis</i>	B270	15	April 26, 1990	5	10.0	8.0
		B271	15	April 26, 1990	5	32.0	8.0
		B272	15	April 26, 1990	5	22.0	4.0
	<i>P. thunbergii</i>	B276	15	April 26, 1990	5	15.5	7.0
		B277	15	April 26, 1990	5	31.0	8.0

Note: TA-1 was used as inoculum.

reported that sporodochia of the pitch canker pathogen occurred commonly on diseased branches of slash pine in Florida. BLAKESLEE *et al.* (1979) also reported that airborne conidia of *F. subglutinans* were trapped during each sampling period in all seasons of the year. No sporodochia has been found on diseased branches of Ryukyu pine on Amamioshima Island. Also, we could not find any other places where *F. subglutinans* produced much conidia. The life cycle of the pitch canker fungus should be clarified. On Amamioshima Island, the pitch canker originally was found in Tatsugo-cho, R(20). The disease recently spread to Nase-shi, R(23) and to Kasari-cho, R(22) on Amamioshima Island. The pitch canker fungus on newly damaged sites

was examined. *F. subglutinans* was isolated from Ryukyu pines in these two regions (Table 4).

Table 5 shows the results of isolation tests of *F. subglutinans* from sugar cane. It was isolated from 22 out of 49 sample pieces. No experiments to demonstrate its pathogenicity on sugar cane have been made. In the United States, it had been isolated from the tissues of rice, gladiolas, dracaena, and soil in pine stands. In Japan, no experiments have been made to isolate it from such plants.

The results of isolation tests are summarized in Fig. 3. In the future, the investigations of the west area and other islands except Amamioshima Island of Kagoshima Prefecture, should be made.

Table 6 shows results of inoculation tests of *F. subglutinans* on pine species. Isolates from Ryukyu pine on Amamioshima Island caused shoot dieback of seedlings of Ryukyu, Virginia, and Monterey and caused branch dieback on slash pine. This fungus also caused resinous stem cankers on Ryukyu and Japanese black pines. (Table 6 and Fig. 4).

As shown in Table 6, all three Ryukyu pines and two of five Japanese black pines were infected. Isolates of *F. subglutinans* from Japanese red pine in Kirishima-cho killed branches of Ryukyu pines. In all inoculation tests, it showed the pathogenicity to injured pines. Seedlings were killed by it during the 3~5 weeks after inoculations.

In the United States, 12 species of pines are affected with pitch canker fungus (BLAKESLEE *et al.*, 1980). DWINELL (1978) reported that shortleaf and Virginia pines were very susceptible, and that slash pine was intermediate in susceptibility, whereas loblolly pine was more resistant. He also reported that the shoot mortality of loblolly, slash, Virginia, and shortleaf pines differed according to the pine source of inocula (DWINELL *et al.*, 1977). In the inoculation tests of TA-1, the pathogenicity of *F. subglutinans* isolates from Tatsugo-cho against Ryukyu, slash, Japanese black, Virginia, and Monterey pines were not distinct. As the inoculation tests with *F. subglutinans* isolates from the codling moth and Japanese red pine in Kirishima-cho were done only once, we could not compare the pathogenicities among these two isolates and TA-1. In the future, we should make inoculation tests of *F. subglutinans* isolates from loblolly pine in Kedoin-cho, Tsuruta-cho, and Hishikari-cho. Although the pine pitch canker has never been found on the main island of Kyushu, the existence of pathogenic *F. subglutinans* raises the possibility of an outbreak of pine pitch canker on Kyushu.

Table 7 shows the dimensions of cankers on inoculated stems. Resinous cankers developed in the vertical direction (Fig. 4.). DWINELL *et al.* (1977) reported that the death of pines and dieback of large branches are caused by repeated infections. Pines inoculated with *F. subglutinans* will live for some years. In this study, the distribution of *F. subglutinans* on Kyushu and the pathogenicity of the fungus were clarified. In the future, we need to study whether pathological differences exist among the many isolates including those from sugar cane and other crops.

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