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收穫前 논의 벼줄기에 感染된 *Fusarium moniliforme* 에서의 *Gibberella* 子囊殼의 發生

성재모・스나이더*

水原農村振興廳, 農業技術硏究所, 美國캘리포르니아大學校*

Before Harvest Occurrence fo *Gibberella* Perithecia of *Fusarium moniliforme* on Infected Rice Stems In field

Jae Mo Sung* and William C. Snyder**

Inst. of Agsicultural Sciences, Office of Rural Development, Seoweon, Korea

Abstract

This study was made in order to determine which *Gibberella* species were occurring on rice stems and seeds in the field, and their survival 5 months after harvest time.

An average 12% of plants infected with 'Bakanae' disease occurred in 4 fields planted with non-treated seed.

Prior to harvest, more perithecia of *Gibberella moniliformis* occurred on infected rice stems than of *Gibberella rosea*. But *Gibberella rosea* was most common on the seed, and perithecia of this species also survived best until spring.

F. moniliforme, *F. roseum* and *Ophiobolus* sp. were isolated from seedlings planted from naturally infected seed at the rates of 10, 25 and 8% respectively and from infected stems at rates of 3, 10and 2% respectively. Perithecia of *Gibberella rosea* survived through the winter on naturally infected rice stems when kept dry indoors, buried in field soil, or places in straw stackes in the field. They did not survive on straw left on the soil surface during the very cold and dry conditions of the 1976—'77 winter.

Introduction

Gibberella is a very important pathogen over the world. In 1884 W.C. Smith (9) discovered *Fusisporium culmorum* now known as *F. roseum* 'graminearum' for the first time and named it the cause of wheat scab. Many researchers isolated this fungus from host plants. According to Selby (7), wheat blighting was caused by *Fusarium roseum* Link, with the perfect stage is *Gibberella saubinett* (Mont) Sacc. Snyder and Hansen (10) rearranged and unified the genus *Fusarium*. The perfect stage of *Fusarium roseum* was designating as *Gibberella rosea* (Link) Snyder & Hansen sp. cerealis. This paper follows Snyder and Hansen's system of indentification.

* Institute of Agricultural Sciences, Saweon, Korea
** University of California, Berkeley California, 94720 U.S.A.

Nishikado (3) repeorted that perithecia were observed on rice seedlings in seed beds. In Korea Park(5) reported that *Fusarium graminearum* attacked wheat and barley but he did not find the Gibberella stage. Lee(2) reported that perithecia were formed on rice stems and straw in Korea. According to Ishii Kidai(1) rice stem infected by *F. moniliforme* were observed to produce perithecia in Japan but he did not determine which species of Gibberella were present.

Two major crops in Korea are rice and wheat. Bakanae disease is causing increased dammage to rice, particularly since, mercury has been prohibited as a seed treatment.

This study was carried out to determine which species of *Gibberella* were present on stems infected by *Fusarium moniliforme* before harvest, and which species of *Fusarium* had attacked seedlings through the seed. The primary inoculum was provided by infected seed and by Perithecia of both *G. rosea* 'Graminearum' (Syn. *Gibberella zeae*) and *G. moniliformis* (Syn. *Gibberella fujikuroi*) present on infected straw lying on the soil or present in straw stacks.

Materials and Methods

At harvest time the number of rice stems infected with bakanae disease was surveyed at four locations. Stems bearing perithecia were collected and observed under the microscope and cultured on P.S.A. and water agar.

100 seeds were collected from plants infected by *Fusarium moniliforme*, and 100 seeds were inoculated with spores from infected, all were planted on sterilized sand. At the seedling stage plants were sterilized for 1 minutes with 1% sodium hypochlorite and cultured on P.S.A. and water agar.

Perithecia on the stems were kept indoors, other stems were buried in field soil, and some were placed in soil or in straw stacks in the field for 5 months. Finally 100 perithecia were cultured on P.S.A. and water agar in order to know whether they had survived or not.

Results and discussions

Most of the elongated seedlings showing Bakanae symptoms caused by *F. moniliforme* were pulled out at weeding time together with wild grasses in the seed bed.

Yet a on average of 12% of the plants infected with bakanae disease occurred in 4 fields planted with non-treated seed. Pyungtack, Yongin A, Yong in B and Hongchen were infected at 8.4, 15.0, 14.9 and 9.8% respectively. The average percent of diseassed plants was doubled when the number of removed seed bed infections was added to these field totals.

Table 1. Number of rice stems infected with bakanae diseases (*F. moniliforme*) at harvest time at four locations

Place	No. of stems examined	No. of infected stems	Percentage
Pyungtack	107	9	8.4
Yongin A	224	34	15.0
Yongin B	127	19	14.9
Hongchun	153	15	9.8
Average			12.0

Infected rice stems with perithecia and seeds were collected at four locations before harvest. These perithecia were cultured on P.S.A. and water agar.

As shown in Table 2, all 50 perithecia collected at Pyungtack were *G. moniliformis*. Yongin A of a total of 490 perithecia, 260 were *G. moniliformis*, and 230 were *G. rosea*, at Yongin B of the 450 perithecia, 243 were *G. moniliformis*, and 207 *Gibberella rosea*, at Hongchen of 230 perithecia, 140 were *Gibberella moniliformis* and 90 *G. rosea*. All of the 100 perithecia found on seed at Kimhae were *G. rosea*, and the 50 perithecia on seed at Chunchen also were *G. rosea*.

Perithecia from seed at Kimhae and Chuncheon were observed to be *G. rosea* "Graminearum". So, prior to harvest, more perithecia of *Gibberella moniliformis* occurred on infected rice stems than of *Gibberella rosea*. But *Gibberella rosea* was most common on the seed, and the perithecia of this species also survived best on straw until spring.

According to Watanabe (11), operithecia were found on the rice stem infected by *Fusarium moniliforme*. Most of the perithecia belonged to *Gibberella moniliforme*. But *Gibberella rosea* "Graminearum" was not isolated from perithecia formed on infected rice stem.

Table 2. Individual *Gibberella* perithecia cultured from infected rice stems at A location, at harvest time

Places	No. of perithecia cuitured	No. of *G. monili-formis*	No. of *G. rosea*
Pyungtack	50	50	—
Yongin A	490	260	230
Yongin B	450	243	207
I Chun	230	140	90
Kim hae (Seed)	100	—	100
Chunchen (Seed)	50	—	50

Rostrup (6) (1893) reported that the scab fungus overwintered on seed and attacked seedings.

In this study perithecia on seed were *G. rosea*.

G. rosea is abundant in the field and form perithecia easily since it is homothallic.

As shown in Table 3, 23 stems infected by *Fusarium moniliforme* formed perithecia before harvest time. These perithecia were cultured on P.S.A. and water agar. The mycelium of *Gibberella rosea* developed a reddish color, grew fast (about 8 cm after a week), and produced macroconidia on water agar. But the mycelium of *G. moniliformis* appeared vinacious and whitish yellow in color, and grew slower (about 4cm after week) and formed microconidia in macroconidia on both P.S.A. and

Table 3. Species of *Gibberella* perithecia cultured from rice stem

No. of stem	Ascospore septation	Color of mycelium on PDA	Presence of conidia Micro	Presence of conidia Macro	Diameter of colony	Species
1	immature	reddish	—	+	8	roseum
2	〃	vinacious	+	+	3.7	moniliforme
3	〃	〃	+	+	4	〃
4	〃	reddish	—	+	8.0	roseum
5	〃	whitish yellow	+	+	4.3	monliforme
6	one	〃	+	+	4.0	〃
7	immature	〃	+	+	4.0	〃
8	〃	〃	+	+	4.3	〃
9	〃	〃	+	+	4.2	〃
10	〃	〃	+	+	4.0	〃
11	〃	〃	+	+	4.0	〃
12	Two-three	reddish	—	+	8.3	roseum
13	three	〃	—	+	8.0	〃
14	immature	whitish yellow	+	+	4.3	moniliforme
15	〃	reddish	—	+	8.0	roseum
16	three	〃	—	+	8.0	〃
18	two	〃	—	+	8.3	〃
20	immature	〃	—	+	8.0	〃
21	three	〃	—	+	8.0	〃
22	one	whitish yellow	+	+	4.0	moniliforme
23	one	〃	+	+	4.3	〃
24	one	〃	+	+	4.0	〃
25	one	〃	+	+	4.3	〃

WA. Most of the 2—3 septate ascospore at maturity belong to *F. rosea.*

Most of the immature perithecia belonged also to the species *F. moniliforme.*

230 perithecia collected from rice stem before harvest were cultured among them, 90 perithecia were *F. roseum* and 140 were *F. moniliforme.* Rice stubble and corn stems collected the following spring time had formed perithecia. These perithecia belonged mostly to *G. rosea,* as determined by culturing them.

According to Ishil Kidai (1) perithecia formed on rice straw are important as primary inoculum of *F. roseum.* Ogawa (4) reported that the removal of rice debris from wheat fields decreased damage by 10 percent. Fusarium *moniliforme* perhaps is less likely to form perithecia because of its heterothallic nature.

The rice stems infected by *F. moniliforme* formed perithecia at harvest time and these perithecia shoot ascospores which infect rice heads. Rice grain and the infected stems overwintered and infect seedlings in the bed in the following spring. Therefore, in order to control bakanae diseases, clean seed must be planted and the infected straw in the field destroyed. But *F. roseum* is quite different from *F. moniliforme. F. roseum* is abundaut over the entire field, overwintering as perithecia, mycelium in the debris and chlamydospore in the soil. Perithecia are continually formed on rice straw, corn stem, wild grass as well as on wheat and barley stems. The perithecia shoot ascrspores when conditions are favorable. Wheat and barley stems and heads as well as those rice and corn are attacked by *F. roseum* 'Graminearum'.

Table 4. Identity of *Gibberella* perithecia collected from rice stems

No. Perith. / Seasons	Total No. of perithecia	*G. rosea*	*G. mnoliformis*
Before harvest (Sept.)	230	90	140
Following spring time (April)	120	120	—

This fungus form perithecia on wheat and barley stems and heads easily under wet condition. These perithecia are of importance as primary inoculum.

100 seeds naturally infected by *F. moniliforme* were collected from the field and 100 healthy seeds were inoculated with spores from infected stems, all were planted onsterilized sand. As a result, *F. moniliforme, F. roseum* and *Ophiobolus sp.* were isolated from seedlings planted from the naturally infected seed at the rate of 10, 25, and 8 percent respectively, and from seed inoculated from infected stems at the rates of 3, 10 and 2 respectively. Nishikado (3) reported that seedling infected by *F. roseum* were killed at very young stages and formed perithecia. Disease smyptoms appeared on the stem surface. In the 3—4 leaf stage seedlings were killed by *Ophiobolus* and formed perithecia on the stem at the ground level. Bakanae disease occurs in seed beds, but does not kill the attacked seedlings immediately. The diseased seedlings grow somewhat abnormally, showing a taller and more slender appearance of leaves and culms than those with normal growth. Their color becomes yellowish-green to pale in the advanced stage.

Bakanae fungus invades inside the stem producing the primary infection.

Table 5. Pathogens recovered from rice seedlings grown from seed naturally infected in the field and from that inoculated with spores from infected stems

No. of seeds planted	No. of plants infected with *F. moniliforme*	*F. roseum*	*Ophiobolus*
Collected 100	10	25	8
Incoullated 100 From infected stem	3	10	2

As a result, 43% of the seeds were infected, 10% with *F. moniliforme,* 25% with *F. roseum* and 8% with *Ophiobolus.* Seeds inoculated with spores from infected stems yielded 3% *F. moniliforme,* 10% *F. roseum* and 2% *Ophiobolus.* These findings emphasize the need for an effective seed treatment such as mercury.

Perithecia of *Gibberella rosea* survived thoughout the winter on naturally infected rice stems when kept dry indoors, buried in field soil, or placed in straw stacks in the field.

They did not survive on straw left on the soil surface in the field during the very cold and dry conditions prevailing in the 1976—77 winter. According to Watanabe (11) perithecia of *Gibberella moniliformis* survived 9 months when kept dry indoors.

Table 6. No. of perithecia of *Gibberella* surviving on rice stems from the field after 5 months exposure (Oct. to Feb.)

Stem indoors dry	100/100	100/100
*In the field on soil	100/100	0/100
In the field in soil(5—10cm)	100/100	100/100
In straw stack in field	100/100	100/100

*Very dry and very cold exposure

摘　　要

圃場에서 키다리病에 걸린 줄기와 種子로 부터 얻은 자낭각이 어느 種類의 *Gibberella*에 存在하며, 收穫後에 얻은 자낭각의 生存여부를 調査하기 위하여 처리한 結果는 다음과 같다.

1. 種子消毒을 하지 않은 圃場에서 키다리病의 罹病率은 平均 12%이었다.

2. 收穫前에 얻은 자낭각은 키다리병의 자낭각이 적미병의 자낭각보다 많았으나 種子나 볏에 채집한 자낭각은 거의 적미병에 있었다.

3. 키다리병에 이병된 벼에서 채종한 種子에서 키다리병, 적미병, *Ophiobolus* sp.는 10, 25, 8%로 나타났으며 罹病된 줄기로 부터 얻은 胞子로 接種한 種子에서는 3, 10, 2%로 나타났다.

4. 적미병자낭각을 야외 땅속 실내 집눌속에 놓고 5개월이 지난다음 生存여부를 調査한 結果 야외에 놓은 것만 발아하지 않았다.

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