한국식물보호학회지 : 제20권 제 2 호
Korean J. Pl. Prot. 20(2) : 71~75(1981)

Ecological Studies on Rice Sheath Blight Caused by *Rhizoctonia solani*

I. The Difference of Disease Development Between Jinheung and Yushin

Chang Kyu Kim*, Chang Sik Kang*, Sa Joon Rim**,
Eun Jong Lee*, and Kyung Hee Lee***

잎집무늬마름病의 生態學的硏究

1. 振興과 維新의 發病差異

金章圭*·姜昌植*·林思俊**·李銀鍾*·李庚徽***

ABSTRACT

The percentage of lesion height vs. plant height was higher in Yushin than Jinheung within the same nitrogen level. The infection occurred at the same level of waterline and the symptoms developed with the same speed for two varieties, but the damage was greater in Yushin as the symptoms reached faster to the top due to the short length of the lst and 2nd internodes from the top

INTRODUCTION

As one of the major rice diseases, sheath blight caused by *Rhizoctonia solani* is taking an important role in reducing rice yield in Korea. Since Tongil type variety was developed and disseminated in a large scale, the acreage infected with sheath blight was increased annually (ORD. 1980). Under the field conditions the symptom first appears near the waterline in late June or early July. The lesions continuously develop and spread during the vegetative phase and finally reach to flag leaf or panicle axis during the ripening phase.

Favorable factors for disease development are known as high density of sclerotia, early cultivation, early maturing variety, high nitrogen fertilizer application, dense transplanting, continuous high temperature and etc (Hori et. al, 1971).

In the present study, Jinheung and Yushin were tested in order to investigate the different phases of disease development with two different levels of nitrogen fertilizer application in relation with percentages of infected hills, stems and lesion height, density of overwintering sclerotia, lesion index and the length of internodes. The authors are deeply indebted to Mr. Hong Sik Min for his sincere assistance during the investigation of this

* 農業技術硏究所, 水原, 韓國 170. Institute of Agricultural Sciences, Suweon, Korea 170.
** 大韓農藥株式會社, 서울, 韓國. Daehan Agricultural Chemical Company, Seoul, Korea.
*** 農村振興廳 技術普及局, 水原, 韓國 170. Technical Dissemination Bureau, ORD, Suweon, Korea 170.

study.

MATERIALS AND METHODS

Varietis Tested

Two varieties, Jinheung representing Japonica variety and Yushin representing Tongil type variety, were used throughout the experiment.

Fertilizer Level

Standard level of fertilizers N:P:K for Jinheung were 11 : 6 : 7 kgs and for Yushin 15 : 9 : 10 kgs per 10a. 2N plots were 22 kgs for Jinheung and 30 kgs for Yushin per 10a.

Sample Size

Twenty five hills were selected at the center out of 500m²/N level/variety. The plants for observation were preliminarily marked and measured for various factors throughout the experiment.

Field Observation

The plants were transplanted on May 26 and growth status of the plants and outbreak/development of disease were periodically checked by ten-days interval from June 21 until September 11 in 1976, 1977 and 1980.

RESULTS AND DISCUSSION

For plant height a Japonica variety Jinheung was taller than Tongil type variety Yushin during the crop season and the difference became greater since August 1st showing 18 to 22 centimeters taller in Jinheung regardless of nitrogen fertilizer level. In contrast, Yushin maintained more tillers than Jinheung(Table 1). These two factors, plant height and number of tillers, gave a great effect on disease development between two varieties.

The symptom of sheath blight appeared at late June or early July and developed fast from middle July until early August (Table 2). Percentage of infected hills and stems increased from July 11 (Table 3). Both the number of infected stems and percentages of infected hills/stems showed fast increase at the early stage of disease development while percentage of lesion height resulted in gradual increase (Table 4). Percentage of lesion height vs. plant height was over 50% at early September in 2N plot of Jinheung and 1N plot of Yushin. However, Jinheung 1N plot was less than 50% until September 11 while Yushin 2N plot showed over than 50% from August 11. Percent-

Table 1. Growth status of two varieties, Jinheung and Yushin at two different nitrogen fertilizer levels.

Date observed	Jinheung				Yushin			
	1N[a]		2N		1N		2N	
	Plant[b] height	Number of tiller	Plant height	Number of tiller	Plant height	Number of tiller	Plant height	Number of tiller
June 21	40.9[c]	12.9	45.6	17.1	36.4	14.3	37.7	15.5
July 1	35.9	15.8	60.9	19.6	44.6	20.9	50.2	26.2
11	63.7	16.4	73.4	20.1	54.4	21.1	62.9	29.4
21	72.0	14.1	83.0	18.1	61.1	18.3	63.1	24.5
Aug. 1	83.7	13.9	100.6	17.3	70.4	16.3	76.2	20.6
11	103.4	13.7	113.9	16.9	85.0	15.6	87.5	16.5
21	112.6	13.4	122.1	16.5	94.3	14.3	97.1	17.6
Sept. 1	112.9	13.2	122.4	15.3	99.6	13.8	99.2	16.4
11	112.7	13.0	122.2	15.7	95.5	13.8	99.0	16.9

a: 1N and 2N mean 110kg/ha and 220kg/ha of nitrogen fertilizer applied for Jinheung and 150kg/ha and 300kg/ha for Yushin.

b: Plant height is measured by centimeters.

c: Means are obtained from 25 hills in 1976, 1977 and 1980.

age of lesion height vs. plant height itself is useful to understand the level of lesion at the time of lesion reading but is insufficient to know on which specific part of the plant the top lesion is located. The location of top lesion is imporant as it is being a criterion in determining the damage by sheath blight at maturing stage. Therefore, the lesion index, meaning the highest position of lesion was deviced by the senior author and utilized (Kim et. al., 1976, 1977 and 1980).

As indicated in Table 5, lesion index was checked periodically at ten-days interval from August 11 until September 11. Lesion index was higher in 2N plots and in Yushin than Jinheung. For Jinheung 2N plot, the top lesion was presented on the middle of the third leaves from the top in August 11 and reached on the middle of the second leaves after one month. In relation to the percentage of lesion height vs. plant height, it was increased 16% from 40.5% to 56.5% during the same period in the same plot (Table 4). On the contrary, for Yushin 2N plot, the top lesion was developed from the second leaf sheath to the flag leaf sheath during the same period while the percentage of lesion height vs. plant height was increased 13.9%. These facts indicated that the infection started at the same height of waterline, but the damage became greater in short plant type Yushin. The difference of plant height between Jinheung and Yushin was investigated in terms of the length of internodes (Table 6). There was not much difference for the third, fourth and fifth internodes from the top between two varieties while the length of the first and second internodes of Jinheung was longer than that of Yushin resulting about 7 and 6 centimeters longer, respectively

Table 2. Mean number of stems infected with *R. solani* in varieties Jinheung and Yushin at two different nitrogen fertilizer levels.

Date observed	Jinheung		Yushin	
	1N[a]	2N	1N	2N
June 21	0[b]	0.03	0	0.04
July 1	0.9	0.7	0.4	1.1
11	1.5	4.4	2.6	7.3
21	3.4	7.6	4.6	13.6
Aug. 1	6.1	13.6	10.5	16.2
11	7.1	14.6	11.2	14.5
21	7.3	15.1	11.2	15.0
Sept. 1	7.8	14.2	10.7	15.3
11	7.6	13.6	9.6	14.0

a: 1N and 2N mean 110kg/ha and 220kg/ha of nitrogen fertilizer applied for Jinheung and 150kg/ha and 300kg/ha for Yushin.
b: Means are obtained from 25 hills in 1976, 1977 and 1980.

Table 3. Percentage of infected hills and stems by *R. solani* in varieties Jinheung and Yushin at two different nitrogen fertilizer levels.

Date observed	Jinheung				Yushin			
	1N[a]		2N		1N		2N	
	Hills	Stems	Hills	Stems	Hills	Stems	Hills	Stems
June 21	0[b]	0	2.7	0.1	0	0	4.0	0.2
July 1	8.0	0.5	37.3	3.6	17.3	1.7	34.7	3.3
11	52.0	8.6	73.3	20.0	62.7	11.7	61.3	19.8
21	53.3	22.1	78.7	42.7	65.3	24.8	74.7	55.3
Aug. 1	62.7	42.1	89.3	76.8	85.3	60.5	89.3	74.2
11	62.7	49.8	90.7	85.1	84.0	67.6	82.7	80.3
21	62.7	52.3	93.3	90.5	85.3	75.1	90.7	84.2
Sept. 1	70.1	58.0	96.0	92.8	89.3	76.8	100	92.8
11	73.3	56.4	100	86.3	89.3	66.6	93.3	82.9

a: 1N and 2N mean 110kg/ha and 220kg/ha of nitrogen fertilizer applied for Jinheung and 150kg/ha and 300kg/ha for Yushin.
b: Means are obtained from 25 hills in 1976, 1977 and 1980.

Table 4. Percentage of lesion height vs. plant height in varieties Jinheung and Yushin at two different nitrogen fertilizer levels.

Date observed	Jinheung		Yushin	
	1N[a]	2N	1N	2N
June 21	0[b]	5.0	0	7.2
July 1	10.5	16.5	19.8	12.3
11	18.6	18.8	20.6	23.4
21	24.7	25.1	22.8	30.4
Aug. 1	27.7	38.0	34.1	45.7
11	31.2	40.5	37.8	50.2
21	37.7	48.6	46.2	54.9
Sept. 1	40.2	55.2	50.7	59.3
11	43.5	56.5	58.8	64.1

a: 1N and 2N mean 110kg/ha and 220kg/ha of nitrogen fertilizer applied for Jinheung and 150kg/ha and 300kg/ha for Yushin.
b: Means are obtained from 25 hills in 1976, 1977 and 1980.

Table 5. Comparison for lesion index[a](the highest position of sheath blight lesion) between varieties Jinheung and Yushin at two different nitrogen fertilizer levels.

Date observed	Jinheung		Yushin	
	1N[b]	2N	1N	2N
Aug. 11	1.9[c]	2.4	2.3	3.3
21	3.0	3.4	3.6	4.1
Sept. 1	3.2	4.1	4.2	4.2
11	3.8	4.6	4.9	5.2

a: Lesion index 6 means the lesion presents on flag leaves.
Lesion index 5 means the lesion presents on the sheaths of flag leaves.
Lesion index 4 means the lesion presents on the 2nd leaves from the top.
Lesion index 3 means the lesion presents on the sheaths of 2nd leaves.
Lesion index 2 means the lesion presents on the 3rd leaves from the top.
Lesion index 1 means the lesion presents on the sheath of 3rd leaves or below.
b: 1N and 2N mean 110kg/ha and 220kg/ha of nitrogen fertilizer applied for Jinheung and 150kg/ha and 300kg/ha for Yushin.
c: Means are obtained from 25 hills in 1976, 1977 and 1980.

Table 6. Comparison for internode length between varieties Jinheung and Yushin at two different nitrogen fertilizer levels.

Variety		Internodes from the top				
		1st	2nd	3rd	4th	5th
Jinheung	1N[a]	37.7[b]	21.8	10.8	9.3	3.1
	2N	38.1	23.5	14.9	11.8	6.6
Yushin	1N	30.0	17.0	14.7	8.5	4.3
	2N	31.0	16.9	14.7	0.3	4.4

a: 1N and 2N mean 110kg/ha and 220kg/ha of nitrogen fertilizer applied for Jinheung and 150kg/ha and 300kg/ha for Yushin.
b: Means are obtained from 10 stems in 1976 and measured by centimeters.

Table 7. Percentage of disease occurrence and density of overwintering sclerotia of *Rhizoctonia solani* in varieties Jinheung and Yushin at two different nitrogen fertilizer levels.

Variety		Percentage of disease occurence[a]	Number of sclerotia per 10^3m^2
Jinheung	1N[b]	22.0[c]	$10^3\times892$[d]
	2N	47.5	$10^3\times1,491$
Yushin	1N	36.8	$10^3\times1,131$
	2N	54.9	$10^3\times2,411$

a: Percentage of disease occurrence was calculated as follows; $\frac{3n_1+2n_2+1n_3+0n_4}{3N}\times100$, where
n_1 means number of tillers where lesions reached to the flag leaf/sheath,
n_2 means number of tillers where lesions reached to the second leaf/sheath,
n_3 means number of tillers where lesions reached to the third leaf/sheath,
n_4 means number of healthy tillers,
N means total number of tillers observed.
b: 1N and 2N mean 110kg/ha and 220kg/ha of nitrogen fertilizer applied for Jinheung and 150kg/ha and 300kg/ha for Yushin.
c: Means are obtained and measured on September 21 from 25 hills in 1976, 1977 and 1980.
d: Means are obtained from five places of one square meter each, in March, 1977.

(Kim et. al., 1977).

Percentage of damage at maturing stage by sheath blight was greater in Yushin and in 2N plots within the same variety (Table 7). Th s same relationship was found for number of over-

wintering sclerotia.

Based upon these results, it was concluded that the percentage of lesion height vs. plant height was higher in Yushin than Jinheung within the same nitrogen level. It was also concluded that the infection occurred at the same level of water-line and the symptoms developed with the same speed for two varieties, but the damage was greater in Yushin as the symptoms reached faster to the top due to the short length of upper internodes.

摘 要

1976年, 1977年 및 1980年의 3個年間 振興과 維新을 供試, 窒素質普肥區와 倍肥區로 나누어 6月 21日부터 9月 21日까지 生育 및 잎집무늬마름病의 發病調査를 實施한 結果,

1. 生育狀況에 있어서는 振興이 維新보다 草長이 길었으며 8月 1日 以後에는 窒素施肥水準에 關係없이 18~22cm 길었다. 그러나 分蘖數에 있어서는 維新에서 많았다.

2. 初發은 6月下旬 또는 7月上旬으로 7月中旬~8月上旬사이에 發病株率과 莖率이 急速히 增加하였다.

3. 草長에 對한 病斑높이의 百分率을 나타낸 病斑高率에 있어서는 9月初旬에 50% 內外였으며 維新倍肥區에서는 8月 11日以後에 50%를 넘었다.

4. 調査株에서 제일 높이에 病斑이 位置한 葉位 또는 葉鞘位를 調査하여 病斑指數로 나타낸 結果 成熟期에 가까운 9月 21日 調査에서 振興倍肥區는 次葉의 中間, 維新倍肥區는 止葉의 葉鞘에까지 到達되어 있었다.

5. 上位 第1節부터 第5節까지의 節間長을 比較한 結果, 第3,4,5節의 길이는 두 品種間에 別差異가 없었으나 第1節과 第2節에서는 振興이 各各 7~6cm 길었다.

結論的으로 病斑高率에 있어서는 같은 窒素施肥水準內에서 維新이 振興보다 높았으며 같은 높이에서 發病이 始作되고 病斑進展速度가 같아도 上位 第1, 第2節間長의 길이가 짧은 維新에서 被害가 많았다.

LITERATURE CITIED

Hori, M and M. Anraku. 1971. Studies on the forecasting techniques of sheath blight of rice plant. (In Japanese, English summary); Yamaguchi Agri. Exp. Sta. Special Bulletin No. 24 : 3.

Kim, C.K. and C.S. Kang. 1976. Studies on the forecasting of rice diseases. (In Korean); Research Report for 1976. Inst. Agri. Sci., ORD. (Disease and Insect Section). 28—39.

Kim, C.K., C. S. Kang and S.J. Rim. 1977. Studies on the forecasting of rice diseases. (In Korean); Research Report for 1977. Inst. Agri. Sci., ORD. (Disease and Insect Section). 85—96.

Kim, C.K. and S.J. Rim. 1977. Relationship between outbreak of rice sheath blight and lesion height. (Abstr., In Korean); Korean J. Pl. Prot. 16 : 182.

Kim, C.K. and H.S. Min. 1980. Ecological studies of rice sheath blight and its control. (In Korean); Research Report for 1980. Inst. Agri. Sci., ORD. (Biology Dept. Section). 117-121.

ORD (Office of Rural Development). 1980. Plant Protection Report. (In Korean); 208—209.