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

Ⅱ. Forecasting and Control of Rice Sheath Blight

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벼잎집무늬마름病의 生態學的硏究

Ⅱ. 發生豫察과 防除

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ABSTRACT

To develop forecasting methods of rice sheath blight caused by *Rhizoctonia solani*, two rice cultivars Jinheung (Japonica type) and Yushin (Tongil type) were used from 1976 to 1981. Severity of rice sheath blight disease at maturing stage was estimated by top lesion height, percentage of top lesion height vs. plant height in July and lesion index on September 11. The relationship between top lesion height on July 11 and degree of damage at maturing stage for a cultivar Yushin was represented by the equation of $Y=4.64x-13.2$, and $r=.840^{**}$, where Y is degree of damage by sheath blight at maturing stage and x is top lesion height on July 11. Considering the percentage of infected hills/stems was rapidly increased from July 11 to August 1, the most effective period and time for fungicide spray were considered July 15 and July 25 or July 25 and August 5.

INTRODUCTION

Rice sheath blight caused by *Rhizoctonia solani* is e of the major rice diseases in Korea. Symptoms sheath blight are produced on the lower sheaths the plants. Since the first appearance of the symp- n in late June, the disease spreads to neighbouring ants or develops fast to upper parts of the plants vored by high temperature, high humidity or dense ant spaces. In most cases of rice diseases the basic ategy for control is through host resistance. However, the only effective control of rice sheath blight is with chemicals since no varieties are known to be resistant to the disease[1].

In the previous study, it was found that the level of damage by sheath blight was associated with the height of lesion present on the uppermost position of the plant[4]. The main objective of forecasting is aimed to control the disease most effectively and it is important to know that at what growth stage a factor more seriously affects the damage. The purpose of this study was to find the relationship between lesion height during vegetative growth stage

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and degree of damage at maturing stage based upon the results obtained during 1976~1981 crop seasons. At the same time period and time for chemical control of sheath blight were investigated. The authors extend their thanks to Dr, E.K. Cho, Plant Pathology Dept., IAS, for his advice during the preparation of this manuscript.

MATERIALS AND METHODS

Cultivation Practices: Two rice cultivars Jinheung (Japonica type) and Yushin (Tongil type) were used for development of forecasting method of sheath blight. 40 day old seedlings were transplanted on May 26 in 1976, 1977, 1980 and 1981 at 500m²/cultivar with 27×15cm transplanting space. Fertilizers were applied with a mixture of 110, 60 and 70kgs of N, P_2O_5 and K_2O per hectare for Jinheung and 150, 90 and 100kgs for Yushin. For chemical control experiment a Tongil type cultivar Seogwangbyeo was used. Experimental design was completely randomized design (CRD) with three replications. Each plot size was 33m² and fungicide used in this experiment was Neoasozin 6.5 LC diluted 1,500 times with water.

Data collection: Twenty five hills/cultivar were preliminarily labeled at the center of 500m² and following items were periodically measured by ten days interval from June 21 to September 21.

Percentage of infected stems

$$= \frac{\text{Total number of infected tillers}}{\text{Total number of tillers from 25 hills}} \times 100$$

Lesion height = Average top lesion height of 25 hills

Percentage of lesion height vs. plant height

$$= \frac{\text{Top lesion height}}{\text{Mean plant height}} \times 100$$

Lesion index was periodically checked by ten days interval after the exsertion of flag leaves[4].

Degree of damage was calculated by Yoshimura's method[5] at maturing stage which is represented by the equation of

$$\text{Degree of damage } (\%) = \frac{3n_1+2n_2+1n_3+0n_4}{3N} \times 100$$

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 reach to the third leaf/sheath,

n_4 means number of healthy tillers, and

N means total number of tillers observed.

Regression equation was obtained by percentage infected stems, lesion height, percentage of lesi height vs. plant height and lesion index as indepe dant variables and degree of damage at maturi stage as a dependant variable.

RESULTS

Relationships Between Factors of Disease Dev opment and Degree of Damage

There are several factors affecting degree of d mage by sheath blight at maturing stage, i.e., pe centages of infected hills and infected stems, lesi height, percentage of lesion height vs. plant heigh lesion index and density of overwintering scleroti Out of these factors, lesion heights of July 1 Jinheung, July 11 and July 21 in Yushin were high significant with degree of damage (Table 1, Figur 1 and 2). In the meantime, the relationship betwe percentage of lesion height vs. plant height ar degree of damage was found significant only c July 1 in Jinheung (Table 2). The relationship w represented as $Y=1.59x+14.1$, and $r=.714^*$, whe Y is degree of damage by sheath blight at maturin stage and x is percentage of lesion height vs. pla height on July 1. However, there was no significa relationship found for the cultivar Yushin.

Lesion index which was derived from the positio of top lesion on a specific leaf sheath or leaf blad had significant relationships on September 11 fc both Jinheung and Yushin with degree of damge a maturing stage (Table 2).

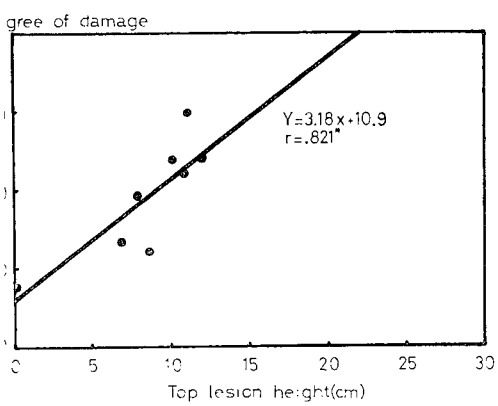
Effective Periods and Times of Chemical Appli ation for Rice Sheath Blight Control:

Since the primary inoculum for the infection c rice sheath blight has been known as overwintere sclerotia, elimination of floating sclerotia just befor transplanting is considered to be the most effectiv way to reduce yield losses due to the sheath bligh disease. However, it is not able to eliminate the p

Table 1. Simple linear regression between percentage of infected stems, height of top lesion of rice sheath blight and degree of damage at maturing stage in two rice cultivars Jinheung and Yushin.

Items[a)]	Cultivar	Date observed	Correlation coefficient	Regression equation
Percentage infected stems	Jinheung	July 1	.474[ns b)]	$Y=1.13x+32.7$
	Yushin	July 21	.530[ns]	$Y=0.23x+36.9$
Lesion height	Jinheung	July 1	.821*	$Y=3.18x+10.9$
		August 1	.584[ns]	$Y=0.92x+8.1$
	Yushin	July 11	.840**	$Y=4.64x-13.2$
		July 21	.790*	$Y=2.24x+5.4$
		August 1	.584[ns]	$Y=0.85x+19.6$

a) Percentage of infected stems(%) $= \frac{\text{No. of infected stems}}{\text{No. of healthy stems}} \times 100$.
Lesion height=Top lesion height of the hill.
b) **: Significantly different at 1% level.
*: Significantly different at 5% level.
ns: Not significantly different.



g 1. The relationship between top lesion height measured on July 1 and degree of damage caused by rice sheath blight at maturing stage in rice cultivar Jinheung.

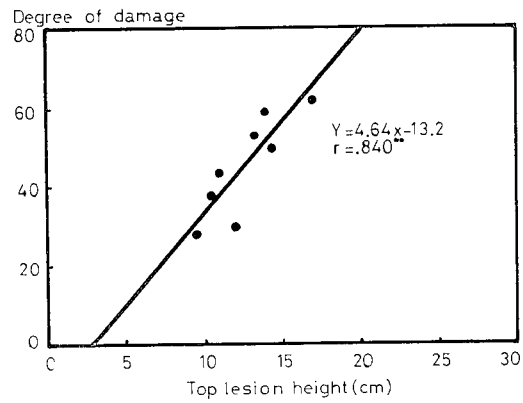


Fig. 2. The relationship between top lesion height measured on July 11 and degree of damage caused by rice sheath blight at maturing stage in rice cultivar Yushin.

ıary inoculum source completely. And the control ocedure is mostly dependant upon fungicide appli- tion.

As shown in Table 3, any combination of two or ree times fungicide application gave satisfactory ıtrol effect to reduce damage by sheath blight. ıt two times application by 20 days interval, July) and August 5, was less effective than by ten ıys interval.

DISCUSSION

As a principle method for the estimation of degree of damage by sheath blight, Yoshimura's method has long been used. However, this method is applicable only at maturing stage of rice plant and it has been pointed out as a limitation in predicting the damage before maturing stage. To develop more efficient method for the estimation of degree of damage, a lot of efforts have been made by Hashiba[2)] and Kim *et al.*[3,4)] for several years.

Table 2. Simple linear regression between percentage of top lesion height vs. plant height, lesion index and degree of damage at maturing stage in two rice cultivars Jinheung and Yushin infected with *Rhizoctonia solani*.

Items[a]	Cultivar	Date observed	Correlation coefficient	Regression equation
Percentage lesion height	Jinheung	July 1	.714*[b]	$Y=1.59x+14.1$
		August 1	.685[ns]	$Y=1.39x-9.9$
	Yushin	July 11	.567[ns]	$Y=2.27x-1.1$
		July 21	.660[ns]	$Y=1.53x+5.6$
Lesion index	Jinheung	September 1	.690[ns]	$Y=10.28x+1.0$
		September 11	.787*	$Y=18.64x-35.3$
	Yushin	September 11	.774*	$Y=18.72x-44.1$

[a] Percentage of lesion height(%) $=\frac{\text{Top lesion height}}{\text{Plant height}}\times 100$

Lesion index one through six was based on the location of top lesion on leaf sheath or blade in a plan

[b] * : Significantly different at 5% level.

ns: Not significantly different.

Table 3. Effect of chemical control for rice sheath blight depending upon periods and numbers of application in a Tongil type cultivar Seogwangbyeo[a].

Date of chemical application	Degree of damage at maturing stage[b]
July 15	22.7 b[c]
July 25	20.3 b
August 5	19.6 bc
July 15 and July 25	6.5 d
July 15 and August 5	10.0 cd
July 25 and August 5	7.1 d
July 15, July 25 and August 5	2.6 d
Control	39.9 a

[a] Fungicide used in this experiment was Necasozin 6.5 LC diluted 1,500 times with water.

[b] Degree of damage was calculated by Yoshimura's method[5] and means were obtained from ten hills per replication in 1981.

[c] Means not followed by the same letter are significantly different at the .05 level of probability as determined by DMRT.

Three factors, top lesion height, percentage of top lesion height vs. plant height and lesion index, related with sheath blight development were measured and analyzed to find the relationship in estimating degree of damage at maturing stage. Top lesion height of the plants during July had highly significant relationsphips with degree of damage at maturin stage. This indicated that the infection occurred b *R. solani* during late June or early July gave mo favorable conditions for disease development than th rice plants infected later due to the high temperatu and humidity followed by vigorous tillering. As result rapid development of sheath blight lesion t the upper parts of the plants resulted in greate damage at maturing stage.

In estimating degree of damage at maturing stag based upon percentage of top lesion height vs. pla nt height, the relationship appeared to be differen from that of top lesion height. For a Japonica cultiva Jinheung, both top lesion height and percentage o top lesion height vs. plant height measured on Jul 1 had highly positive correlations with degree o damage. On the contrary a Tongil type cultiva Yushin showed highly positive correlations betwee top lesion height of July 11 and July 21 and degre of damage but not with percentage of top lesio height vs. plant height. Recently Hashiba *et al.*[2] do cumented that the degree of sheath blight incidenc was able to estimate using percentage of top lesio height vs. plant height and it was more reasonabl to measure disease development of rice sheath bligh to upper parts of the plant than top lesion heigh due to the small standard deviation. However, th standard deviation of top lesion height for Yushi

/as smaller than percentage of top lesion height vs. lant height in July. Considering that the damage by ice sheath blight was greater in a short plant type ulivar Yushin as the symptoms reached fast to the op of the plant due to the short length of upper nternodes[4], both top lesion height and percentage of top lesion height vs. plant height were important for the estimation of degree of damage at maturing stage depending upon cultivars and growth stages especially in July.

Lesion index on September 11 was found to be highly significant with degree of damage for both cultivars Jinheung and Yushin. However, the presence of lesion on a specific leaf sheath or blade in the middle September can be considered as the degree of damage, the lesion index at this stage is not practical fo rthe estimation of damage even though t has highly positive correlations. The lesion index immediately after the exsertion of flag leaf has no significant relationship with degree of damage because the lesions were able to continue upward development until middle September. If the lesion ndex in early August is significant for the estimation of damage, estmation of lesion index can contribute to decide fungicide application since the chemical control at this growth stage is still quite effective to minimize damage by sheath blight.

For chemical control of sheath blight incidence, two or three times application of fungicide by ten days interval was very effective to depress sheath blight incidence. Since the percentage of infected hills/stems was rapidly increased from July 11 to August 1[4], and significant relationship was found between degree of damage and top lesion height, the most effective period and time for chemical control were considered July 15 and July 25 or July 25 and August 5.

摘 要

벼 잎집무늬마름病의 發生豫察方法을 開發하기 爲하여 1976年부터 1981年까지 振興과 維新을 供試하여 試驗하였다. 그 結果 成熟期의 잎집무늬마름病 被害度는 7月中의 病斑높이와 病斑高率, 9月 11日의 病斑指數에 依하여 推定할 수 있었다. 維新品種에 있어서 7月 11日의 最上位病斑 높이와 成熟期의 被害度와의 關係는 $Y=4.64x-13.2$, $r=.840^{**}$ 이었다. 한편 藥劑防除時期와 回數試驗結果는 잎집무늬마름病의 發病株率과 發病莖率이 7月 11日에서 8月 1日 사이에 急激히 높아지는 事實과 7月中의 病斑높이와 成熟期의 被害度와는 相關이 높은 것을 勘案할 때 7月 15日과 7月 25日 또는 7月 25日과 8月 5日의 10日間隔 2回防除가 가장 效果的이었다.

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