A New Method Developed for Estimating The Disease Incidence of Sheath Blight of Rice

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ABSTRACT

The experiements were conducted in the 1st and 2nd crops of 1981 to develop a new method for estimating the degree of disease incidence of sheath blight and to clarify the characteristics of rice varieties in relation to the disease incidence. The results indicated that early maturing varieties were more susceptible to sheath blight than that of late maturing varieties, while tall varieties and varieties with few tillers were less susceptible to sheath blight disease. The degree of disease incidence of sheath blight (Yoshimura's method) could be estimated with the percentage of the height of the uppermost infected parts to the plant height by using the following formulas, $Y = 1.451 X - 37.256$ for the 1st crop and $Y = 1.064 X - 17.993$ for the 2nd crop. The value X could also be estimated by using the following formulas, $X = 0.823 Z + 12.205$ for the 1st crop and $X = 0.904 Z + 7.505$ for the 2nd crop.

The formulas developed in the experiments were very similar to Hashiba's formulas reported last year, $Y = 1.62 X - 32.4$ and $X = 0.73 Z - 4.13$.

It will be more efficient and time saving for rice researchers to estimate the disease incidence of sheath blight by using these formulas than using Yoshimura's method.

INTRODUCTION

Sheath blight is one of the most inportant diseases of rice in Taiwan. It commonly occur both in the 1st and 2nd crops. The average infected area from 1965-1981 was about 12-19 percent of the total rice cultivated area (*1*).

In order to find an efficient method for screening varietal resistance, various inoculation methods and disease scaling standards have been developed (4). In Taiwan, field screening test for selecting varietal resistance to sheath blight is an importent step of rice breeding program. Usually both artificial

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inoculation and natural infection screening tests were to be employed (6). However, in terms of disease scaling method, Yoshimura's formula was most commonly used while IRRI's scaling method was also used by some researchers (6.7). Since both Yoshimura's formula and IRRI's scaling method are very laborious and inconvenient that a more efficient scaling method is needed for estimating the degree of disease incidence. Therefore the present study is to develop a new method for estimating the degree of disease incidence of sheath blight of rice.

MATERIALS AND METHODS

The experiments were conducted in the 1st and 2nd crops of 1981 at the experimental field of Tao Yuan District Agricultural Improvement Station. Rice varieties or lines, 226 for 1st crop and 214 for 2nd crop, in the experiments were collected from Dr. Huang of Taiwan Agriculture Research Institute. Each variety or line was planted in 3 rows, each row with 5 plants. Inoculation was made when rice plant reached maximum tillering stage, 45 days after transplanting in the 1st crop and 30 days after transplanting in the 2nd crop, by placing the straw inoculum in the rice hill. The major characteristics of rice plant such as plant height, tiller number and heading date were recorded. The degree of sheath blight disease incidence was investigated by using Yoshimura's formula (8), while the height of the uppermost infected part of each plant was also measured. Percentage of the height of the uppermost infected parts to the plant height was also calculated using the following formula.

$$X\ (\%) = \frac{\text{Height of the uppermost infected part}}{\text{Plant height}} \times 100$$

Yoshimura's formula was described as following:

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

n_1 = The number of tillers with all the 4 uppermost leaf sheaths and leaf blades infected.

n_2 = The number of tillers with the 2nd and 3rd leaf sheaths from the top infected.

n_3 = The number of tillers with 3rd leaf sheath infected.

n_4 = The number of tillers with no infection.

IRRI's scaling standard was also listed for reference:

1 = Lesions limited to lower 1/4 of leaf sheath.

3 = Lesions on lower 1/2 of leaf sheath.

5 = Lesions on more than 1/2 of leaf sheath, slight infection on 3rd and 4th leaves or from the top.

7 = Lesions on more than 3/4 of leaf sheath with severe infection on lower leaves and slight infection on upper leaves.

9 = Severe infection on all leaves.

Data obtained from the experiments were analysed with correlation analysis by using T.I 990 Model 1 microcomputer.

RESULTS

The degree of disease incidence (Yoshimura's method) in relation to the mojor characteristics of rice varieties. The results of the experiment showed that in the 1st crop the disease incidence was negatively correlated with plant height and heading date of rice plant but positively correlated with tiller number of rice plant. The results corobarated the reports of other researchers (2.6.7). However, in the 2nd crop the correlation coefficience was not significant between disease incidence and plant height or tiller number (Table 1).

Table 1. The correlation coefficience among sheath blight disease and the major characteristics of rice varieties.

Character	Correlation Coefficience	
	1st crop	2nd crop
Degree of disease incidence and plant height	-0.236**	-0.081
Degree of disease incidence and tiller number	0.150*	-0.071
Degree of disease incidence and heading date	-0.368**	-0.556**
Height of the uppermost infected parts and plant height	0.308**	0.267**
Height of the uppermost infected parts and the percentage of the height of the uppermost infected parts to the plant height	0.797**	0.865**
The percentage of the height of the uppermost infected parts to the plant height and degree of disease incidence	0.832**	0.713**

* Means significant at 5% level.

** Means significant at 1% level.

Data were analysed by using TI 990 Model 1 microcomputer.

Plant height in relation to height of the uppermost infected part. The result of the correlation analysis showed that the height of the uppermost infected parts was positively correlated with plant height. The regression line for the 1st crop was Y = 0.293 X + 23.887 (Y = plant height, X = height of the uppermost infected part). The results indicated that the higher the rice plant the higher the lesion could reach.

The degree of disease incidence (Yoshimura's method) in relation to the percentage of the height of the uppermost infected parts to the plant height. The results of the analysis showed that the disease incidence of sheath blight was positively correlated with the percentage of the height of the uppermost infected parts to the plant height. The regression line for the 1st crop was Y = 1.451X - 37.256, while for the 2nd crop was Y = 1.064 X - 17.993 (Y = degree of disease incidence, X = the percentage of the height of the uppermost infected parts to the plant height) (Fig. 1 and Fig. 2).

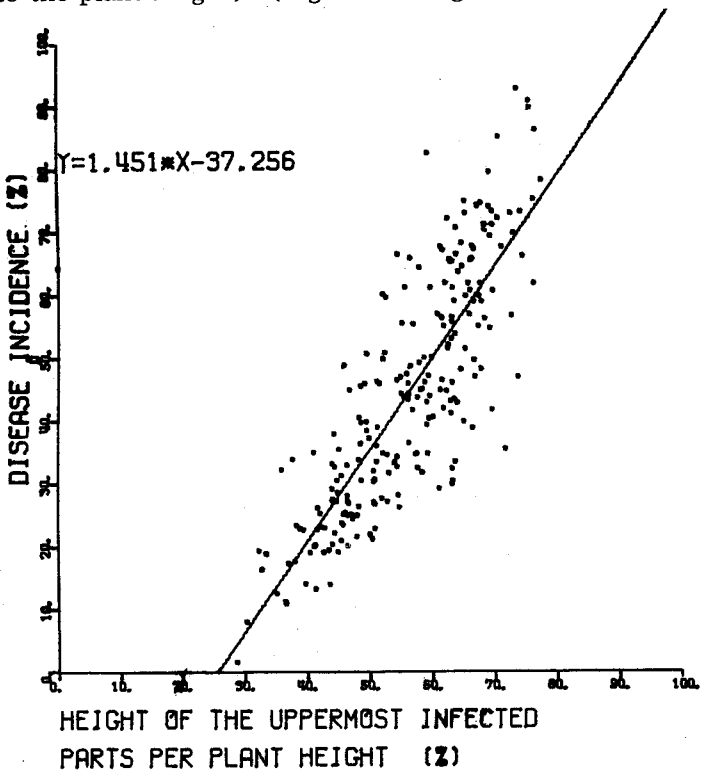

Fig. 1. Correlation between the disease incidence (Y) and the percentage of the height of the uppermost infected parts to the plant height (X) of the 2nd crop.

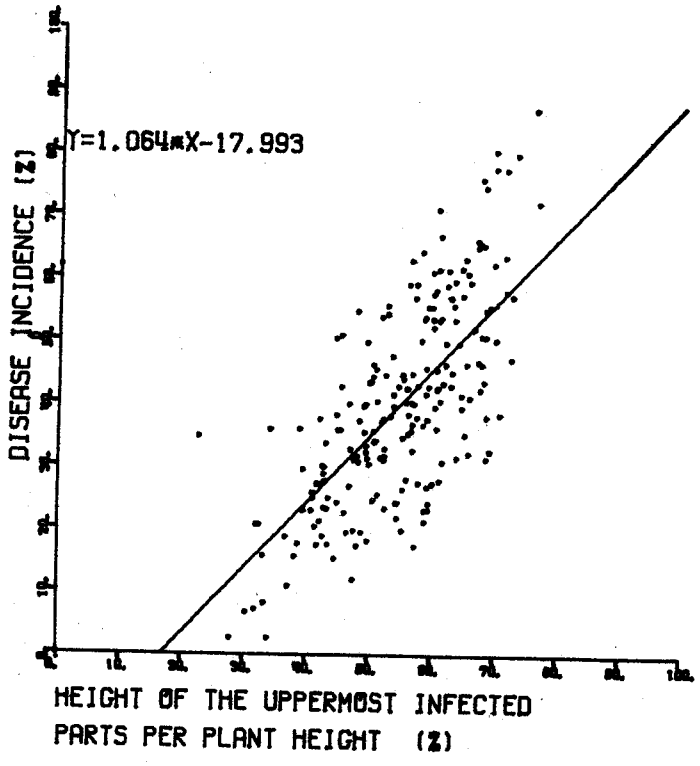

Fig. 2. Correlation between the disease incidence (Y) and the percentage of the height of the uppermost infected parts to the plant height (X) of the 2nd crop.

The height of the uppermost infected parts in relation to the percentage of the height of the uppermost infected parts to the plant height. The results of the correlation analysis showed that the height of the uppermost infected parts was positively correlated with the percentage of the height of the uppermost infected parts to the plant height. The regression line for the 1st crop was $X = 0.823\ Z + 12.205$, while for the 2nd crop was $X = 0.904\ Z + 7.505$. (X = the percentage of the height of the uppermost infected parts to the plant height, Z = the height of the uppermost infected parts) (Fig. 3 and Fig. 4).

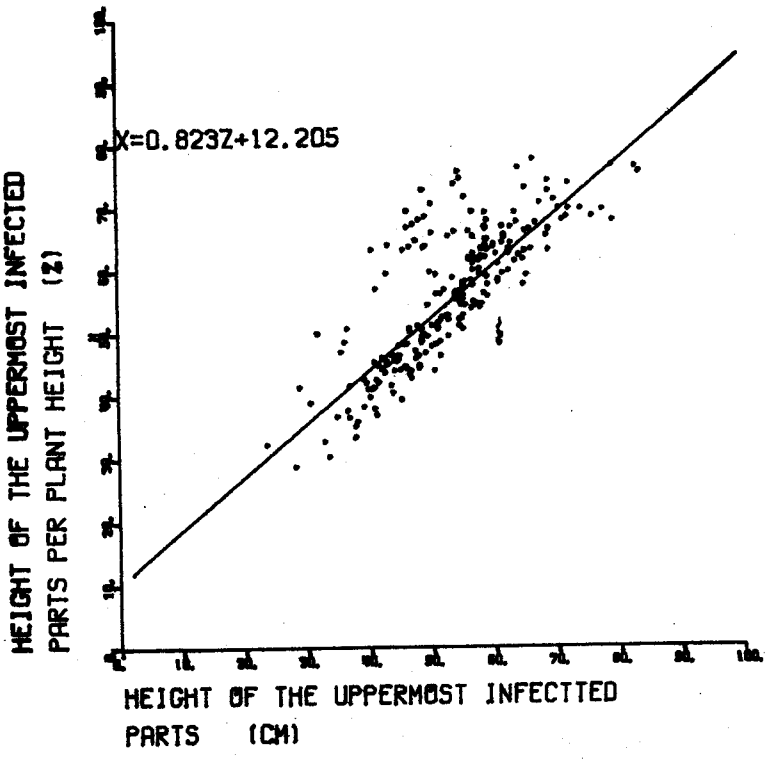

Fig. 3. Correlation between the percentage of the height of the uppermost infected parts to the plant height (X) and the height of the uppermost infected parts (Z) of the first crop.

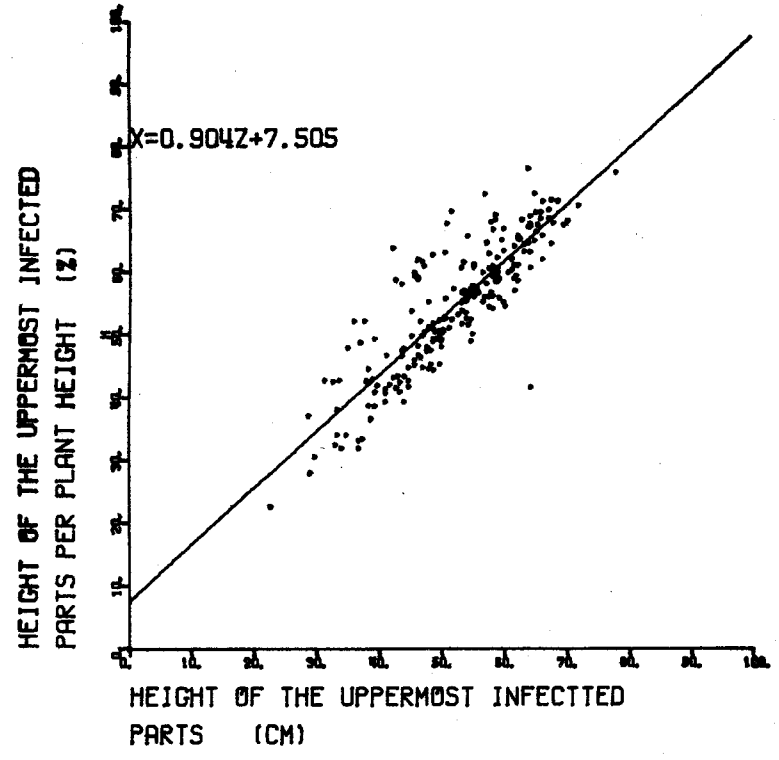

Fig. 4. Correlation between the percentage of the height of the uppermost infected parts to the plant height (X) and the height of the uppermost infected parts (Z) of the second crop.

DISCUSSION

The results of the experiments showed that early maturing varieties were more susceptible to sheath blight disease than that of late maturing varieties. However, rice varieties with tall plant height or few tillers were less susceptible to sheath blight. The results revealed that resistance of rice varieties to sheath blight disease might be greatly related to the morphological and phsiological characteristics of rice plant. Hashiba suggested that leaf sheaths of late maturing varieties might be nutritionally less favarable for the fungal growth than those of the early maturing varieties and he concluded that the vertical spread of sheath blight was correlated with the quantitative change of nitrogen and starch in the leaf sheaths (2). However, Su et al attributed the susceptibility of early meaturing varieties to the early consumption of rice nutrition (5). Teng reported that sheath blight lesion could reach the upper part of rice plant earlier on the short varieties than that on the tall varieties (7).

The results of the correlation analysis showed that the height of the uppermost infected parts was positively correlated with plant height. It indicated that the higher the rice plant was the higher the lesion could reach. Therefore, it might be more resonable to estimate the disease incidence of sheath blight by using the percentage of the uppermost infected parts to the plant height than using the height of the uppermost infected parts only. The results of the experiments showed that the degree of disease incidence (Yoshimura's method) was positively correlated with the percentage of the height of the uppermost infected part to the plant height. And the regression line for the 1st crop was $Y = 1.451X - 37.256$, while for the 2nd crop was $Y = 1.064 X - 17.993$. These regression lines were similar to Hashiba's formula, $Y = 1.62 X - 32.4$ (3). The correlation between percentage of the height of the uppermost infected part to plant height and the height of the uppermost infected parts was also analysed. The regression line for the 1st crop was $X = 0.823 Z + 12.205$, while for the 2nd crop was $X = 0.904 Z + 7.505$. These results were also similar to Hashiba's formula, $X = 0.73 Z - 4.13$ (3).

Since Yoshimura's formula and IRRI's scaling standard were laborious and time consuming that the formulas developed from the experiments would be very useful for rice researchers.

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水稻紋枯病被害度估算方法之研究

本省水稻紋枯病被害度之調查基準一直係沿用日人吉村彰治於 1954 年所訂定之方法，最近幾年有些試驗人員亦曾採用國際稻米研究所之調查基準。由於上述兩種方法在田間實際調查時不僅工作效率低且在分別等級時亦容易發生混淆，因此在抗病品種檢定試驗時，被害度之調查對試驗人員而言確實是種吃重的工作。

本試驗結果經TI990 Model 1 微電腦以相關性分析後發現以病斑高度與株高之比率可以準確地估算出紋枯病之被害度，其公式爲第一期作 $Y = 1.451X - 37.256$，第二期作 $Y = 1.064X - 17.993$。此結果與日人羽柴輝良等氏去年之報告很相近，其公式爲 $Y = 1.62X - 32.4$ 。

本試驗亦同時再證實早熟品種較晚熟品種感病，植株高與分蘖少品種較抗病。即紋枯病之發病與水稻品種之特性有很大的相關性。

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