

# Studies on the Occurrence of Rice Black-Streaked Dwarf Virus in Korea.

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韓國에서 벼 黑條萎縮病的 發生에 대하여

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## ABSTRACT

This is the first report on rice black-streaked dwarf virus in Korea. The occurrence of this virus in Korea was confirmed by symptoms on rice plants, vector transmission and microscopic observation in 1975. The smaller brown planthopper, *Laodelphax striatellus* FALLEN, transmits this virus which is spherical with a diameter of about 60 nm. Higher infection was observed in earlier transplanted rice with higher levels of fertilizer than in normal and standard cultivation fields.

## INTRODUCTION

Two rice virus diseases, rice stripe and dwarf virus, are known to occur so far in Korea. Stunt symptoms on rice were discovered at Seonsan region in Gyeongbuk Buk Do in 1973, and which this new disease was identified as rice black-streaked dwarf virus in 1975. Rice black-streaked dwarf virus is known to be restricted to Japan, with this virus disease first reported at Kuribayashi and Shinkai in 1952(5).

This virus is essentially a phloem gall disease transmitted by the smaller brown planthopper, *Laodelphax striatellus*. Shinkai(8) reported this virus is not transmitted by transovarial passage in the smaller brown planthopper, so this differs from rice stripe virus.

Although Iida(3) reported yield losses appeared not to be affected seriously, in Korea the regional occurrence is variable with up to 30 percent infected hills at Seonsan.

Furthermore because of the enlargement of the cropping

area of barley and wheat, which are secondary hosts of rice black-streaked dwarf virus, this virus disease could be a major disease on the rice plant.

This is the first report on rice black-streaked dwarf virus in Korea, and summarizes several investigations and tests pertaining to this virus disease.

## MATERIALS AND METHODS

1. All field surveys were conducted between the period of heading and harvesting. Varietal reaction to this virus disease was investigated at Seonsan region where the infection rate was high.

The effects of transplanting date and application of fertilizer were investigated at Iri.

### 2. Vector transmission test

The overwintering nymphs of smaller brown planthopper, *Laodelphax striatellus* FALLEN, collected at Seonsan in March were inoculated on healthy Jinheung rice seedlings of 2-3 leaf stage for 2 days. The symptoms were read 50 days after inoculation. And this

test was conducted in the greenhouse.

### 3. Observation by Electron Microscope

Ultrathin sections were made to observe the virus particles in the plant cells. Diseased leaf sections 1 x 5 mm, were fixed in 2.5% glutaraldehyde in 0.1M phosphate buffer at pH 7.0 for 90 minutes and post-fixed in 2% Osmium tetroxide. The fixed materials were dehydrated in 75, 90, 95, and 100% of alcohol for 60 minutes.

The materials were embedded in Epon and cut with glass knives with a Sovall MT-2 Ultra-microtome. The ultrathinsections were doubly stained with uranyl acetate and lead citrate and then examined by Hu-11E electron microscope.

## GENERAL SYMPTOMS ON RICE PLANTS

Rice black-streaked dwarf virus is essentially a phloem gall disease, and diseased plants show pronounced stunting with darkening in color of the foliage. The galls appear as elongated swellings extending along major veins on the underside of leaf blades, on the outside of leaf sheaths, and also on stems after heading stage. The color of galls varies from white to dark-brown with irregular length.

The symptoms on rice plants which were discovered in Korea are the same as described before, but phloem galls on leaves have not been observed in the field.

## RESULTS AND DISCUSSION

### Regional Occurrence

Although regional occurrence was thought to be restricted in Youngnam and Honam district in 1975, as shown in Fig.1, this virus was discovered at Cheongju and Boeun in 1976.

These results indicate the distribution of rice black-streaked dwarf virus could be more extensive.

### Varietal Reaction

As shown in Table 1 in the investigation of varietal reactions to rice black-streaked dwarf virus at Seonsan where the percent of infected hills was the highest in 1975, the percent of infected hills was about 20 percent with the varieties Choonggug #41, Milyang #15, Tongil and Yushin which are all resistant to stripe virus. One local variety showed serious yield losses, but yield losses were not completely established.

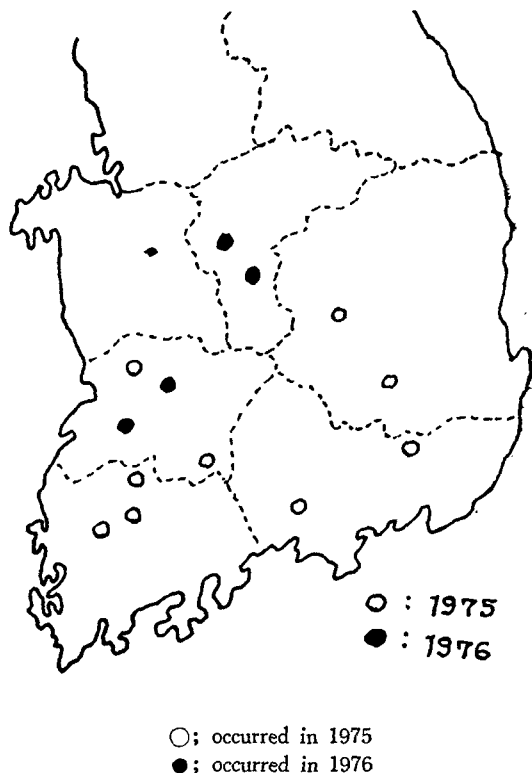


Fig. 1. Regional occurrence of rice black-streaked dwarf virus

Table 1. Varietal reaction to black-streaked dwarf virus

Varieties	Choonggug #41	Milyang #15	Tongil	Yushin
Number investigated	165	159	210	266
Number infected	50	30	33	41
Percent of infected hills	30.3	18.9	15.7	15.4

\* investigated at Seonsan

This result indicates there might be types of varietal resistance to rice black-streaked dwarf virus.

### Effect of Transplanting Date

The percent of infected hills according to the date transplanting was investigated with Milyang #15 and #23 varieties at Iri, and is described in Fig. 2.

The percent of infected hills in rice transplant before June 10 was much higher than that plant after June 10.

In the case of rice stripe disease, it is also known that the earlier transplanting results in increased infection.

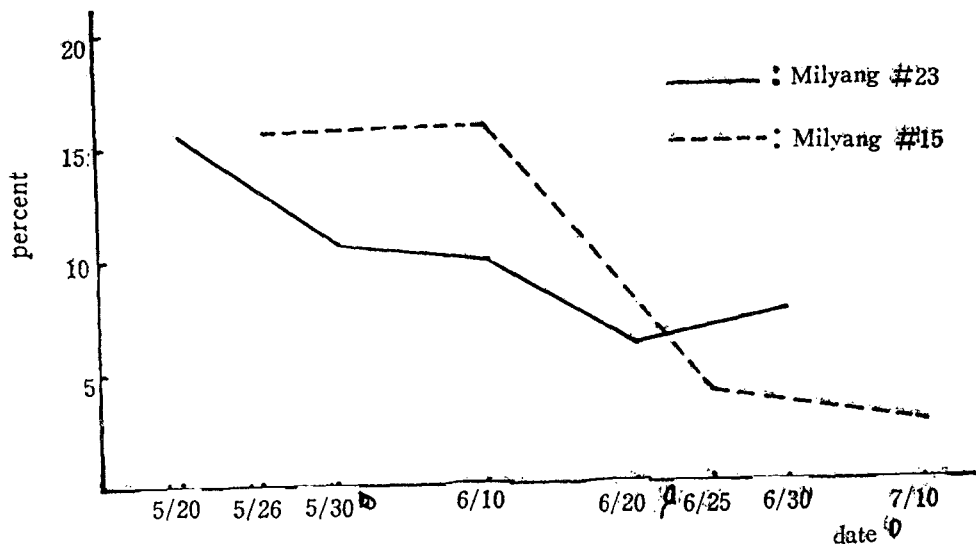


Fig. 2. Effect of transplanting date on the severity of rice black-streaked dwarf virus.

### Effect of Fertilizer Application

Table 2 shows the reaction of rice, Suweon #258, rice black streaked dwarf virus according to different levels of fertilizer application.

The rice plant in multiple fertilized plots showed lesser infection than in standard fertilized plots.

This the same tendency has also been observed with rice stripe virus disease.

Table 2. Variable reaction of rice to black-streaked dwarf virus according to differential levels of fertilizer application.

Levels	standard	increased
Number investigated	206	191
Number infection	47	78
Percent of infected hills	22.8	40.8
P : K (kg/10a)	12:6:9	16:8:12

investigated at Iri

### Vector Transmission

The percent of viruliferous insects infected with rice black streaked dwarf virus was tested with overwintering nymphs of the smaller brown planthopper. The infection rate was 8.8 percent, as shown in Tab. 3.

In this test, the percent of rice black-streaked dwarf virus infected viruliferous insects and rice stripe virus was 10 percent.

Typical symptoms were observed 60 days after inoculation with the appearance of white and brown phloem

Table 3. The percent of viruliferous insect of overwintering *Laodelphax striatella* to rice black-streaked dwarf and rice stripe virus

	RBSDV	RSV
Number of insects tested		80
Number of viruliferous insect	7	8
Percent of viruliferous insect	8.8	10

galls on the leaf sheath and stem after the heading period.

In this test dual infection of rice black-streaked dwarf and rice stripe virus was not confirmed. The variety Jinheung was susceptible to rice stripe virus, and plants severely infected with rice stripe virus wilted before the observations of rice black-streaked dwarf virus could be made.

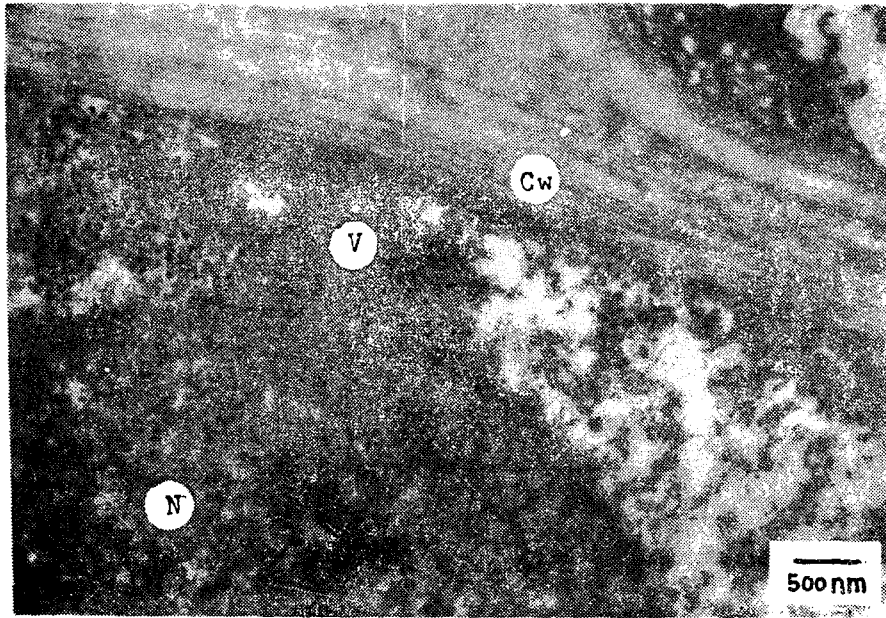
Although Shinkai reported the percent of viruliferous insect of smaller brown planthopper to rice black-streaked dwarf virus was highest with overwintering nymphs, this result could not be compared with others because only one regional experiment was conducted.

### Observation by Electron Microscope

As shown in Fig. 3, the particles of rice black-streaked dwarf virus are spherical, with a diameter of about 60nm.

### CONCLUSIONS

The symptoms, reappearance of phloem galls, vector



N; nucleus Cw; cell wall. V; virus

Fig. 3. Particles of rice black-streaked dwarf virus

transmission tests, and observation of virus particles confirm that the new rice virus, rice black-streaked dwarf virus, presents in Korea.

This virus particles is spherical, with a diameter of about 60nm. Regional occurrence is restricted to southern and middle parts of Korea, and could be more extensive in the future with increased double levels cropping of barley and wheat.

Higher infection resulted from earlier transplanting and use of higher levels of fertilizer application, which is also the case with incidence of the rice stripe virus.

### 摘 要

지금까지 우리 나라에 발생되지 않았던 새로운水稻 바이러스인 벼 黑條萎縮病에 대하여 實施한 確認 및 同定 實驗結果는 다음과 같았다.

1) 애멸구(*Laodelphax Striatellus* FALLEN)가 벼 黑條萎縮病을 媒介하였다.

2) 바이러스의 粒子는 球型이었으며 直徑은 약 60nm 이었다.

3) 이 病은 嶺, 湖南地方 및 忠淸北道에서 發生하였다.

4) 移秧時期가 빠를수록, 多肥일수록 罹病株率이 높았다.

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