Ecological Studies on Rice Sheath Blight Caused by *Rhizoctonia solani* III. Cultural Method and Disease Development

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金章圭·羅東洙·閔洪植(1985) 벼잎집무늬마름病의 生態學的硏究 Ⅲ. 耕種的方法과 發病

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ABSTRACT Transplanting date, planting space and nitrogen level were evaluated for disease development of rice sheath blight using two rice cultivars, Jinheung and Yushin. Sheath blight disease was more severe in early transplanting plot (May 16), narrow planting space(27×12cm) and high nitrogen level (220kg/ha for Jinheung and 300kg/ha for Yushin) conditions than in May 26 transplanting plot, wide planting space (27×15cm) and standard nitrogen level (110kg/ha and 150kg/ha). At the same time, cultural conditions favorable for disease development during growth stage resulted in greater damage at maturing stage.

Disease outbreak and damage of sheath blight are increased by recent change in cultural methods, i.e., early trasplanting and mechanized cultivation. Favorable factors for sheath blight are known as temperature and humidity within the canopy and susceptibility of rice plant[12]. However, these environmental factors within the canopy can be easily affected when the rice plants are subjected to different cultural conditions. Hashiba[3] and Hashiba *et al.*[4] intensively investigated the relationship between disease development and temperature/relative humidity, and developed model curves of vertical and horizontal development of rice sheath blight disease. Kim *et al.*[8] investigated the difference of disease development patterns between two types of rice cultivated in Korea and found that the damage was greater in a Japonica x Indica hybrid cultivar Yushin than in a Japonica cultivar Jinheung due to the short length of internodes in Yushin.

In the present study, disease development phases were investigated under different dates and densities of transplanting and nitrogen levels using two types of cultivar, Jinhenung and Yushin.

MATERIALS AND METHODS

Cultural practices: Jinheung and Yushin were transplanted on May 16 and May 26 with two different spacing levels, 27×15cm (80 hills/3.3m²) and 27×12cm(100 hills/3.3m²). Out of two nitrogen fertilizer levels, standard level of N : P : K for Jinheung was 110, 60 and 70kg per hectare and 150, 90 and 100kg for Yushin. 2N plots were 220kg for Jinheung and 300kg for Yushin per hectare.

Data collection: Fifteen hills/treatment were preliminarily labeled at the centre of 250m² and percentage of infected stems, top lesion height, percentage of lesion height vs. plant height and degree of damage[9] were periodically measured by ten days interval during June 21-September 21 in 1982~1983.

RESULTS

Transplanting date and disease development: Both top lesion height(TLH) and percentage of lesion height vs. plant height(PLHPH) were higher in May 16 transplanting plot than May 26 plot throughout the crop season(Figs. 1 and 2). The lesion was already present in May 16 plot on June 21 but the symptom appeared firstly on July 1 in May 26 plot. The difference of PLHPH between two transplanting dates was greater than that of TLH.

Planting space and disease development: Planting space had less effect on percentage of infected stem (PIS). Fig. 3 illustrates that PIS was almost same between two planting spaces until August 11, but it became higher in 27×12cm plot since August 21. On the contrary, TLH was higher in 27×12cm plot from the beginning and the difference became greater at the later growth stage(Fig. 4).

Nitrogen level and disease development: PIS

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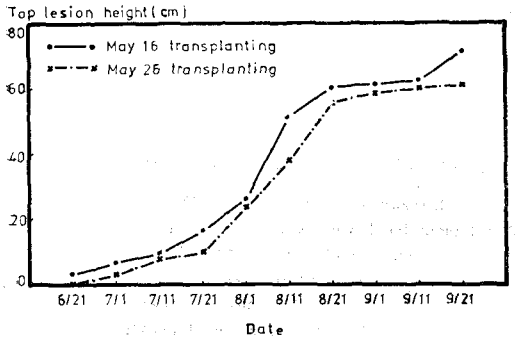

Fig. 1. Effect of transplanting date on the change of top lesion height in Yushin.

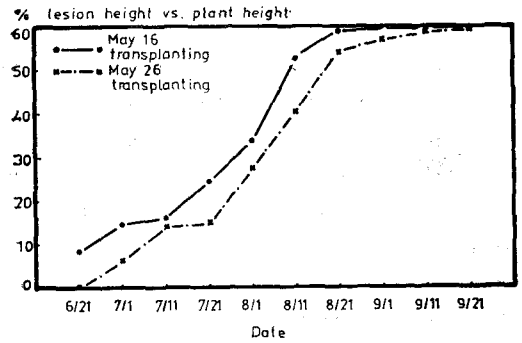

Fig. 2. Effect of transplanting date on the change of percentage of lesion height vs. plant height in Yushin.

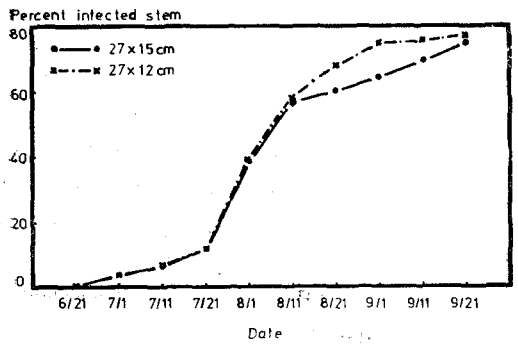

Fig. 3. Effect of planting space on the change of percentage of infected stem in Jinheung.

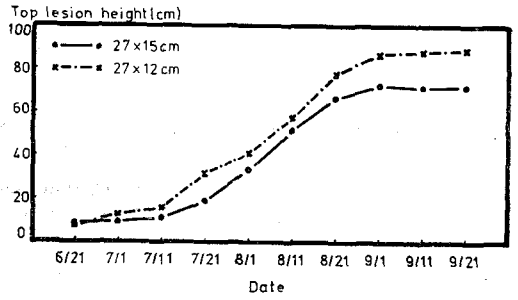

Fig. 4. Effect of planting space on the change of top lesion height in Jinheung.

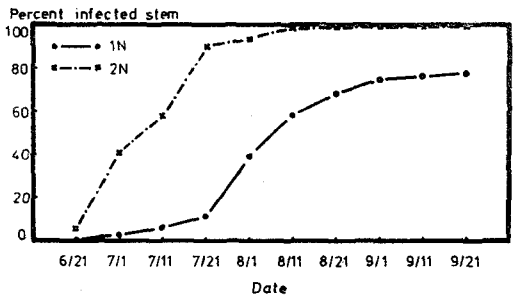

Fig. 5. Effect of nitrogen level on the change of percentage of infected stem in Jinheung.

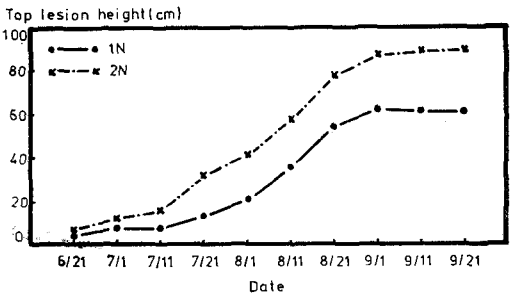

Fig. 6. Effect of nitrogen level on the change of top lesion height in Jinheung.

was greatly affected by nitrogen level. As in Fig. 5, PIS in 1N plot was over 10% on July 21 and gradually increased to near 80% at the later stage. However, PIS in 2N plot exceeded 40% on July 1 and the difference became the greatest on July 21 by exhibiting 90.1% in 2N plot and 12.0% in 1N plot. Likewise, TLH was higher in 2N plot throughout the crop season and the difference became almost 30cm in later stage(Fig. 6).

Cultural practices and degree of damage: Degree of damage by *Rhizoctonia solani* at maturing stage was greater by narrow planting space, early transplanting and high nitrogen level (Fig. 7). At the same time, the damage was greater in Yushin than in Jinheung. In other words, cultural conditions favorable for disease development during growth stage resulted in greater damage at maturing stage.

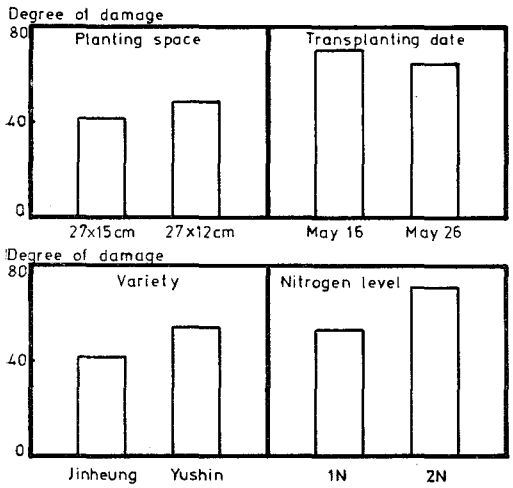

Fig. 7. Effect of cultural practices on the degree of damage by *Rhizoctonia solani*.

DISCUSSION

Out of disease development phases by *Rhizoctonia solani*, percentage of infected stem, top lesion height and percentage of lesion height vs. plant height were periodically measured under different cultural practice conditions, transplanting date, planting space and nitrogen fertilizer level during 1982 and 1983 crop season. Finally, degree of damage was measured at maturing stage at each cultural practice condition. As a result, rice sheath blight disease was favored by early transplanting, narrow planting space and high nitrogen level.

Kozaka[11,12,13] stated that temperature, humidity within the canopy and the resistance of rice plants were the key factors for sheath blight disease. Here, the resistance of rice plant does not mean the genetically controlled resistance, but induced resistance by over dressing of nitrogen fertilizer as well as physiological and morphological characteristics of host plants. The same opinion has also been stated by Ono[14]. In the present study, narrow planting space and high nitrogen level were thought to increase humidity within the canopy and change of physiological characteristics of rice plants, which favored disease development.

In relation with rice sheath blight and early cultivation, many reports have been documented[2,5,6,7,10,15,16]. They indicated that sheath blight disease was favored by early cultivation by increased number of infected tillers and greater damage. Chiba[2] and Hashimoto *et al.*[5] have reported that early cultivation accelerated plant growth and the plants became luxuriant which increased humidity within the canopy and resulted in greater damage by sheath blight. On the contrary, under high nitrogen level, lesion length of sheath blight was longer[1] and number of infected leaf sheath was increased[15].

The factors evaluated in this study, transplanting date, planting space and nitrogen level are variables for disease severity. Under narrow planting space (27×12cm) and high nitrogen level conditions, sheath blight disease was more severe than in wide planting space (27×15cm) and standard nitrogen level plots. The main reason for disease severity in narrow planting space and high nitrogen plots is considered due to the high temperature and humidity within the canopy. Besides, as indicated by Hashiba [3], narrow planting space also increased the chances of contact infection to neighbouring plants. Based upon these results, further studies for the development of sheath blight forecasting model using temperature and humidity within the canopy are needed.

摘 要

振興과 維新을 供試하여 移秧時期, 栽植密度, 窒素施肥 水準과 벼 잎집무늬마름病 發生과의 關係를 檢討하였다. 잎집무늬마름病 發生은 5月 26日 移秧區보다 5月 16日 移秧區에서, 3.3m²당 100株 栽植區가 80株栽植區보다, 窒素質倍肥區(振興 220kg/ha, 維新 300kg/ha)가 普肥區에서보다 發病이 甚하였다. 또한 生育期間中 發病이 甚했던 栽培條件에서 成熟期의 被害度가 높았다.

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