

## Influence of Glabrousness on the Insect Resistance and Some Agronomic Characters in Rice Plant

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### 水稻 매끄러운葉品種과 곱끄러운葉品種에 있어서의 벼멸구 抵抗性, 収量性 및 製玄比率의 比較

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#### ABSTRACT

Comparisons were made between pubescent and smooth leaved cultivars or lines for the brown planthopper feeding preference, adult emergence percent, nymphal period, grain yield and brown rice recovery percent, and found that there were no significant differences of the traits tested between smooth and pubescent.

#### INTRODUCTION

Some land varieties in Southeast countries have smooth leaf. In U.S.A. most of the commercial cultivars are smooth leaved. The glumes of smooth leaved cultivars are also smooth. The smoothness is known to be controlled genetically by a single recessive gene *gl* which belong to the linkage group XII.<sup>(4,5)</sup> Farmers feel better with smooth leaved cultivars through the harvest processing than pubescent ones.<sup>(3)</sup> Smooth grains dry faster and can store more in a unit space than pubescent ones.<sup>(1)</sup> Jodon (1965)<sup>(4)</sup> reported no significant yield difference between pubescent and smooth sister lines segregated in  $F_6$  generation. Dat et al. (1978)<sup>(1)</sup> found no significant yield differences

at several N levels, between pubescent and smooth lines of both short and tall height, but significant differences between tall and short lines due to their differences in N responsibilities. Park (1978)<sup>(6)</sup> reported no significant differences in several quantitative traits including yield among 8 different near-isogenic lines regarding *gl*, *gh* and *wx* genes. Fujimaki (1978)<sup>(2)</sup> found no linkages between smooth leaf and undesirable agronomic traits in  $BC_1F_2$  generation. While, Patanakamjarn and Pathak (1967)<sup>(7)</sup> reported more stemborer infestations on the smooth leaved cultivars than on the pubescent ones.

This paper reports the comparison of feeding preference, adult emergence ratio and nymphal period of brown planthoppers and some agronomical characters between smooth and pubescent lines.

#### MATERIALS AND METHODS

The test lines used here are shown in Table 1. The glabrousness is derived from a Philippine land variety "Malagkit Sinaguang" and the Bph-resistance is derived from "Mudgo". For the comparison of feeding preference, seedlings of 1-1.5 leaf stage were inoculated with Bph-nymphs for 48 hours and counted the number of insects feeding on each plant. For the test of adult emergence and nymphal

Table 1. Characteristics of tested cultivars and lines

Source number	Gene-ration	Leaf	Endosperm	Reaction to Bph*
58662	F5	Glabrous	Glutinous	R
18929	F6	Glabrous	Common	R
58634	F6	Pubescence	Glutinous	R
18679	F5	Pubescence	Common	R
19017	F5	Glabrous	Glutinous	S
5413-3	F5	Glabrous	Common	S
55061	F7	Pubescence	Glutinous	S
40260	F7	Pubescence	Common	S
YT 3	F7	Glabrous	Common	R
YT 12	F7	Glabrous	Common	R
YT 23	F6	Glabrous	Glutinous	R
YT 24	F6	Glabrous	Glutinous	R
Josaeng Tongil		Pubescence	Common	S
Tongil Chal		Pubescence	Glutinous	S

\*Bph: Brown planthopper, R: resistant, S: susceptible.

period, one rice seedling was transplanted in a 2 x 18cm test tube which is filled with rice culture solution and inoculated 5-6 nymphs in each test tube and counted surviving nymphs everyday. Feeding plants were substituted every 3 days. Yield was compared with a pubescent cultivar "Tongil" and a smooth test line "YT 23", under ordinary cultural conditions with five N levels such as 0, 60, 120, 180 and 240 kg/ha. P<sub>2</sub>O<sub>5</sub> and K<sub>2</sub>O were used 80 kg/ha, N and K<sub>2</sub>O were splitted into 4:3:2:1 ratio. SiO<sub>2</sub> and N contents in the flag leaves were analyzed from the plants grown in plots of N = 0, 120 and 240 kg/ha. The brown rice recovery was tested with paddy rices from the pubescent cultivars "Josaeng Tongil" and "Waxy Tongil" and smooth test lines "YT 3" and "YT 12" (which are common) and "YT 23" and "YT 24" (which are waxy rice) (Table 1). Three hundred grams of cleaned paddy rice were tested with 4 replications using "Satake huller".

#### EXPERIMENTAL RESULTS

The number of hoppers infested on the seedlings of resistant group of lines were 6.0 to 7.1 per

seedling while the hoppers on a seedling of susceptible group were 11.6 to 14.6. This kind of differences were found as early as 12 hours after inoculation (Table 2). The number of hoppers feeding on resistant glabrous rice were 6 to 6.4 and on resistant pubescent rice were 6.4 to 11.1. The number of hoppers on the susceptible glabrous rice were 11.6 to 12.7 and on the susceptible pubescent rice were 13.2 to 14.6. The differences between glabrous and pubescent were not significant in both of resistant or susceptible. The difference between waxy and common rice was also not significant.

The percent of adult emergence of the hoppers grown on resistant rice were only 7.3 to 15.8, while the nymphs grown on the susceptible rice, as many as 72.7 to 94.2%, became to the adult hoppers (Table 3). The adult emergence percent on the resistant glabrous were 7.3 to 10.0, and on the resistant pubescent were 14.5 to 15.8, and on the susceptible glabrous were 90.1 to 91.2 and on the susceptible pubescent were 72.7 to 94.2%, showing no distinct differences between glabrous and pubescent in both resistant and susceptible. Differences between waxy and common rice were not significant in any case of resistant or susceptible and

**Table 2.** Feeding preference of brown planthopper on the pubescent or glabrous lines or cultivars.

Reaction group	Leaf character	Endosperm	No. of nymphs per plant after infestation		
			12 hrs.	24 hrs.	48 hrs.
Resistant group	Glabrous	wx	4.8 a*	5.2 a*	6.4 a*
	"	Wx	6.2 a	6.5 a	6.0 a
	Pubescent	wx	6.6 a	6.1 a	6.3 a
	"	Wx	5.2 a	5.9 a	7.1 a
Susceptible group	Glabrous	wx	10.3 b	10.1 b	11.6 b
	"	Wx	13.3 c	12.5 c	12.7 b
	Pubescent	wx	9.6 b	9.8 b	13.2 b
	"	Wx	10.8 b	11.7 bc	14.6 b

wx : glutinous , Wx : non-glutinous , \* Significant statistical difference at 5% level

**Table 3.** The ratio of adult emergence and nymphal period of brown planthoppers reared on pubescent and glabrous rice.

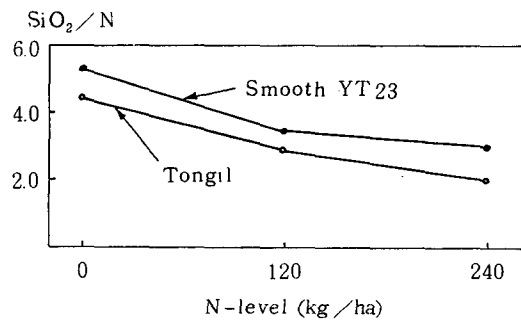
Reaction group	Leaf character	Endosperm	No. of insect tested	Adult emergence (%)	Nymph period (days)
Resistant group	Glabrous	wx	63	10.0	14.6
	"	Wx	55	7.3	15.3
	Pubescent	wx	57	15.8	14.4
	"	Wx	55	14.5	13.5
Susceptible group	Glabrous	wx	57	91.2	13.0
	"	Wx	71	90.1	12.7
	Pubescent	wx	55	72.7	13.1
	"	Wx	52	94.2	12.8

wx : glutinous , Wx : non- glutinous .

glabrous or pubescent.

The nymphal period grown on the resistant rice were 13.5 to 15.3 days while grown on susceptible rice were 12.7 to 13.1 days showing about one day longer on the resistant rice than on the susceptible rice (Table 3). No significant differences of nymphal period were observed between glabrous and pubescent and between waxy and common rice.

The SiO<sub>2</sub> and N contents in the top leaf right after heading were analyzed and compared the ratio of SiO<sub>2</sub>/N. As shown in Figure 1, the ratio of SiO<sub>2</sub>/N decreased along the increased nitrogen level in both smooth rice "YT 23" and pubescent rice



**Fig. 1.** Ratio of SiO<sub>2</sub>/N in leaves of pubescent cultivar and glabrous line at heading stage.

“Tongil”, and the differences between smooth and pubescent are not significant at any level of nitrogen tested. It is believed generally that the deposit of silica on the leaf surface is beneficial for the protection against disease and insects. How the ratio of SiO<sub>2</sub>/N affects to the Bph resistance are not known but at least the fact that the silica deposit is not influence by smoothness of leaves is shown here.

The grain yield of smooth rice “YT 23” and pubescent rice “Tongil” were compared at 0, 60, 120, 180 and 240 kg/ha of N level. As shown in Figure 2 the grain yield was highest at 120 kg/ha N level with both smooth and pubescent rice. The differences of yield due to smoothness and

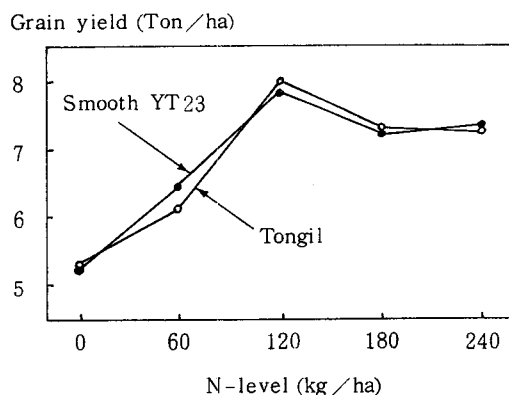


Fig. 2. Grain yield of pubescent cultivar and glabrous line along the different N-fertilizer level.

Table 4. Brown-rice recovery of pubescent and glabrous lines or cultivars. (%):

Leaf character	Non-glutinous			Glutinous		
	120 N	180 N	Diff.	120 N	180 N	Diff.
Pubescent	81.0	81.7	0.7 *	80.8	81.2	0.4 <sup>ns</sup>
Glabrous	81.9	82.8	0.9 *	81.1	81.4	0.3 <sup>ns</sup>
Difference	0.9 **	1.1 **		0.3 <sup>ns</sup>	0.2 <sup>ns</sup>	

\* : Significant at 5 % level  
 \*\* : Significant at 1 % level  
<sup>ns</sup> : Non significance

Pubescent wx: Tongilchal  
 Wx: Josangtongil  
 Glabrous wx: YT 23, YT 24  
 Wx: YT 3, YT 12

pubescence were not significant at all the level of N.

The brown rice recovery was compared between smooth and pubescent rice. As shown in Table 4, the brown rice recovery of pubescent rice were 80.8 to 81.7% and glabrous rice were 81.1 to 82.8%. With nonglutinous rice recovery of glabrous were higher at both 120 and 180 kg/ha than pubescent “Josaeng Tongil”. But, with glutinous rice no significant differences were observed between the pubescent and glabrous. With common rice, though glabrous rice showed higher brown rice recovery here this may be due to the cultivar differences. And the data implies that the brown rice recovery of glabrous rices are as high as the one of pubescent rices.

This was same as in any level of nitrogen and in both non-glutinous and glutinous rice.

## DISCUSSION

Though most of the current economic cultivars in U.S.A. are glabrous ones the adoption of glabrous cultivars in Korea and other Asian countries are still in hesitate. Data that supporting the glabrous cultivars are as productive and tolerable to disease and insects as pubescent cultivars are not enough in Korea. And glutinous cultivars are regarded generally as more susceptible to disease and insects than non-glutinous cultivars. At present, no capable

glabrous glutinous cultivars with resistances to disease and insects are bred and tested by farmers that not only farmers and also extension workers are not ready to accept the new smooth leaved cultivars which might come out near future. To supply the supporting informations for glabrous rice cultivars, tests on feeding preference and adult emergence, grain yield and brown rice recovery were carried out.

The results obtained here on the feeding preference, adult emergence percent and nymphal period of brown planthoppers, are clearly showing no differences between glabrous and pubescent rices. Already there are some papers reporting the possibilities to breed glabrous rice cultivars yielding as high as high yielding pubescent ones in Korea. This paper supports that, in addition to the yielding capability, the effective resistances to the diseases and insects can be transferred to the glabrous lines. Glabrous glumes also do not affect adversely to the milling process and milling recovery.

### 要 約

水稻에 있어서 円滑葉形質의 利用性を 檢討하기 위하여 결끄러운 잎의 品種과 매끄러운 잎의 品種에서 벼멸구抵抗性이 있는 것, 없는 것을 供試하여 円滑葉形質이 벼멸구의 食餌選好性과 羽化率에 미치는 영향을 比較하고, 매끄러운 잎을 가진 品種과 결끄러운 잎을 가진 品種의 收量 및 製玄比率을 比較하였다.

그 結果를 要約하면 다음과 같다.

1. 벼멸구의 食餌選好性, 羽化率 및 抗虫性은 찰과메에 결끄러운 形質 및 찰과메에 따라 差가 나타나지 않았다.

2. 止葉中の  $SiO_2/N$  比率과 收量은 여러 N施用水準에 있어서 잎의 매끄러운 形質과 결끄러운 形

質에 따라 差가 나타나지 않았다.

3. 매끄러운 잎을 가진 系統은 결끄러운 잎을 가진 系統보다 製玄率이 높았는데 메에 있어서만 有意하였다.

4. 매끄러운 잎을 가진 品種의 效用性を 檢討하였다.

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