

# 벼 직파재배시 도복과 관련된 형질 특성

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## Characteristics of Lodging Related Traits of Direct Seeded Rice

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**Objectives** : To analysis which factors relate to lodging characteristics using different varieties(Korea, Japan, USA) in direct seeded rice

### Materials and Methods

Different 9 Varieties ; Gancheok Nongan, Dongjin of Korea, Hitomebore, Hatsuboshi, Koshinikari of Japan, M202, Calrose, Caloro, of USA, were used for this experiment. Number of seedling, leaf age were counted and Photosynthetic rate was measured at 7 main leaf stage using Koito Intelligent Potable Porometer(KIP-8510 version 2.03) Internode length, stem weight, panicle weight, stem diameter, culm length breaking strength were measured. All the breaking strength were measured in two ways. One for at the third internode from the top and the other at 10cm from the plant base(based on soil surface). Cross sectional area was calculated by  $\pi ab$ (where a is half diameter of longest axis, b shortest axis. Lodging index(L.I) was calibrated by moment/breaking strength. Cell wall constituents, starch, lignin and cellulose were determined by detergent analytical method. Statistical methods, correlation and path coefficient analysis were adopted among the collected data.

### Results and discussion

Regarding characteristics of lodging there are many factors, and formed very complicated as a spider line. It should be considered not only single factor but multiple factor.

The stem diameter was highest in Caloro followed by Nongan, M202 and Calrose.

All the USA variety was higher than the others in stem diameter.

In case of culm wall thickness, as shown stem diameter, it was same tendency. The Caloro was obtained highest record in thickness of culm wall. Above two factors are the one of more important traits relation to lodging directly.

The highest breaking strength, 1442g, was record in Caloro and Gancheok Dongjin, transplanted hatsuboshi were observed over 1,000g. After all lodging index was lowest in Hatsuboshi followed by Nongan, Gancheok, and others. Even though breaking strength of USA variety was higher than others, lodging index was high regardless of breaking strength. By the way that parameter doesn't always adapt all the case to express lodging with combined different cultivars. Among the 9 varieties, there were no significant in content of starch but Calrose, Caloro, Dongjin and Koshihikari tended to be higher than others. Relationship between the Cellulose and breaking strength was observed high correlation. With content of lignin, there were very close correlation. In case of culm base weight and lignin and breaking strength, they showed positive correlation.

High content of lignin and cellulose were determined in Nongan, Hatsuboshi(T), Calrose and Caloro. Regarding function of Lignin, it is a hydrophobic materials, enveloping microfibrils and matrix polysaccharides which thicken the wall, cross linked polymers so that the wall becomes very stiff. In lodging Characteristics, stem diameter, thickness of culm wall, bending moment, culm length, breaking strength, cellulose, lignin and culm base weight were close related to lodging index. However most effective characters were summarized by culm length, Stem diameter, thickness of culm wall, and top plant weight among all the varieties according to path coefficient analysis.

table 1. Varietal difference in seedling stand, photosynthetic rate, heading date and No. of panicle under the direct seeding cultivation.

Variety	Established seedling rate (%)	Photosynthetic <sup>1)</sup> rate (mg. CO <sub>2</sub> /dm <sup>2</sup> /hr)	Heading date	Number of panicle per m <sup>2</sup>
Gancheok	87	22.7de	Aug. 18	393b
Nongan	92	26.4ab	Aug. 13	295c
Dongjin	93	25.8abc	Aug. 20	395b
Hitomebore	93	24.6bcd	Aug. 8	467a
Hatsuboshi	94	23.6cd	Aug. 7	467a
Hatsuboshi <sup>(T)</sup>	-	25.2abc	July 31	381b
Koshihikari	93	22.4de	Aug. 13	400b
M202	86	27.5a	Aug. 6	393b
Calrose	95	20.8c	Aug. 18	440a
Caloro	95	25.1abc	Aug. 25	437a

(T): Transplanted rice(25days seedling)  
It was measured on the 7th leaf stage

a, b, c: Means within a column followed by the same letter are not significantly different at the 5% level by DMRT

Table 7. Correlation coefficients of dry weight and content of cell wall material with breaking strength of culm base of direct seeded rice

Trait	Culm base <sup>1)</sup> weight (g)	Starch <sup>2)</sup> (%)	Cellulose <sup>3)</sup> (%)	Lignin <sup>4)</sup> (%)	Breaking strength <sup>5)</sup> (g)
(B)	-0.235				
(C)	0.487	0.429			
(D)	0.779 <sup>a</sup>	0.306	0.667 <sup>a</sup>		
(E)	0.684 <sup>a</sup>	0.280	0.689 <sup>a</sup>	0.940 <sup>**</sup>	

a, a<sup>o</sup>: Significant at 5% and 1% level, respectively

Table 9. Correlation between the traits related to lodging and Lodging Index within a same variety in direct seeded rice

Variety	Culm length (cm)	Top plant weight (g.FW)	Stem diameter (mm)	Thickness of culm wall (mm)	Rate of central gv. (%)	Breaking strength (g)
Nongan	0.867 <sup>oo</sup>	0.728 <sup>o</sup>	-0.760 <sup>oo</sup>	-0.517	0.672 <sup>o</sup>	-0.923 <sup>oo</sup>
Hatsuboshi	0.764 <sup>oo</sup>	0.672 <sup>o</sup>	-0.587	-0.340	-0.478	-0.894 <sup>oo</sup>
Calrose	0.913 <sup>oo</sup>	0.780 <sup>oo</sup>	-0.832 <sup>oo</sup>	-0.673	0.714 <sup>o</sup>	-0.913 <sup>oo</sup>

a, a<sup>o</sup>, o: Significant at 5% level and 1% level, respectively

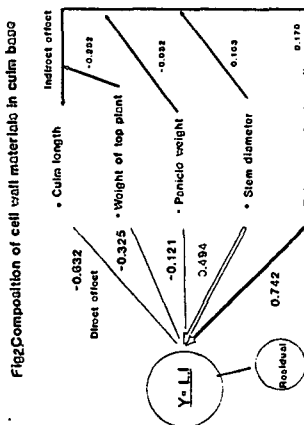
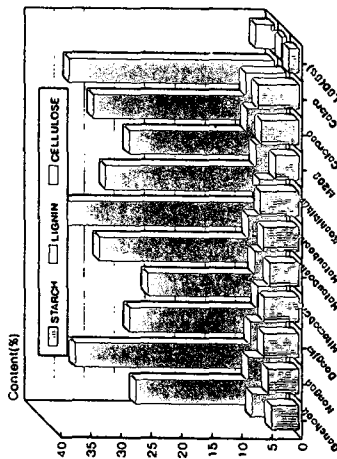


Fig Path coefficient analysis of some characters to lodging

Table 8. Correlation coefficient among the characteristics related with lodging in direct seeded rice

Character	(a) Culm length (cm)	(b) Stem diameter (mm)	(c) A <sub>3</sub> (cm <sup>2</sup> )	(d) Thickness culm wall (mm)	(e) Central gravity (cm)	(f) Rate of Central gravity (%)	(g) Moment (g·cm)	(h) W/CL (g/cm)	(i) Dry weight (g·cm/mm)	(j) W·CL/A (g·cm)	(k) Weight of basal (g/6cm)	(l) Breaking strength (g)	(m) L.I
B	0.275												
C	0.205	0.966 <sup>oo</sup>											
D	0.248	0.835 <sup>oo</sup>	0.859 <sup>oo</sup>										
E	0.528	-0.758 <sup>o</sup>	-0.183	-0.318	0.209								
F	-0.694 <sup>a</sup>	0.537	-0.555	-0.636 <sup>o</sup>	-0.289	-0.882 <sup>**</sup>							
G	-0.851 <sup>oo</sup>	0.680 <sup>o</sup>	0.361 <sup>o</sup>	0.647 <sup>o</sup>	-0.209	0.151	0.312						
H	-0.012	0.770 <sup>oo</sup>	0.857 <sup>oo</sup>	0.645 <sup>o</sup>	-0.555	-0.554	0.782 <sup>**</sup>	0.145					
I	0.791 <sup>oo</sup>	0.348	0.327	0.160	0.585	-0.498	0.090	-0.070	0.034				
J	0.012	0.009	0.064	0.084	-0.414	-0.526	0.454	0.738 <sup>*</sup>	0.245	0.143			
K	0.054	0.733 <sup>o</sup>	0.822 <sup>oo</sup>	0.801 <sup>oo</sup>	-0.374	-0.742 <sup>oo</sup>	0.673 <sup>*</sup>	0.707 <sup>*</sup>	0.396	0.296	0.906 <sup>**</sup>		
L	0.261	0.766 <sup>oo</sup>	0.852 <sup>oo</sup>	0.881 <sup>oo</sup>	0.301	0.678 <sup>*</sup>	-0.275	0.634 <sup>*</sup>	0.109	-0.569	-0.558		
M	0.816 <sup>oo</sup>	0.593	0.023	-0.542	0.751 <sup>oo</sup>	0.301	0.678 <sup>*</sup>	-0.275	0.634 <sup>*</sup>	0.109	-0.569	-0.558	

(T): Transplanted rice(25days seedling)

Table 6. Variation of characters related with lodging in direct seeded rice of different 9 cultivars.

ariety	Stem diameter (cm)	Thickness culm wall (mm)	Central gravity (g)	Rate of central gv. (%)	W/CL (g/cm)	W·CL/A (g·cm)	W·CL/D (g·cm/mm)	W·CL/A (g·cm)	Dry weight of basal (g/6cm)	Breaking strength (g)	Lodging Index
Gancheok	3.04	0.095	43.5	48.7	0.137	224	7178	563	0.27	1081	121
Nongan	4.33	0.147	43.8	44.9	0.178	235	5061	610	0.29	1236	172
Dongjin	3.23	0.102	44.0	43.0	0.136	232	7353	628	0.24	1085	119
Hitomebore	2.80	0.06	49.0	48.9	0.109	196	9150	451	0.18	803	139
Hatsuboshi	3.95	0.07	39.8	48.9	0.109	159	6685	452	0.25	926	104
Hatsuboshi <sup>(T)</sup>	3.52	0.08	40.2	58.5	0.125	151	5438	520	0.20	1151	153
Koshihikari	3.02	0.070	51.4	47.9	0.117	257	1107	495	0.20	772	107
M202	3.98	0.125	44.2	41.8	0.127	187	5960	603	0.24	925	124
Calrose	3.78	0.112	46.8	39.1	0.123	322	8901	717	0.26	1129	139
Caloro	4.38	0.151	42.4	39.1	0.144	255	7403	950	0.30	1442	117

(T): Transplanted rice(25days seedling)  
A: Cross sectional area of culm base  
CL: Culm length  
D: Stem diameter  
I: Node was taken from the 10<sup>th</sup> of the plant base(based on soil surface)  
U: Total Fresh weight of plant above ground  
V: 3rd internode  
W: 3rd internode  
X: Node was taken from the 10<sup>th</sup> of the plant base(based on soil surface)