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Morpho-anatomical Characteristics of Different Panicles in Low and High Tillering Rices

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벼 小蘖性과 多蘖性 品種에서 分蘖別 이삭의 形態 解剖學的 特性

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ABSTRACT : The morpho-anatomical characteristics of panicle in rice plant is generally correlated with the number of spikelets and grain weight per panicle. For the increase of grain yield potential in rice, a low-tillering plant type with large panicles has been suggested as an ideotype. This study was conducted to investigate the panicle morphology and peduncle anatomy of different tillers within a plant in low -and high-tillering cultivars and their relationships on the number of spikelets and grain weight per panicle.

A low-tillering, large panicled IR25588 was compared with a high-tillering, small panicled IR58. IR25588 had more inner(IVB) and outer vascular bundles(OVB), bigger peduncle diameter and peduncle thickness just below the panicle neck node than IR58. The top six tillers(M, P1, P2, P3, P4 and S1P2) within a plant had more IVB and OVB, larger peduncle diameter and thickness than the rest of the tillers in both cultivars. Tillers that emerged earlier had more IVB and OVB than tillers that emerged later. The total number of primary and secondary rachis-branches of IR25588 was much higher than that of IR58. IR25588 had more number of spikelets per panicle than IR58, and the top six panicles showed more spikelets per panicle than the rest of the panicles in both cultivars.

The peduncle diameter was more important than peduncle thickness on the spikelet differentiation and panicle weight, especially in low-tillering cultivars. The number of IVB and OVB were highly correlated with the number of rachis-branches, spikelets and grain weight per panicle. The number of spikelets per IVB and spikelets per primary branch were higher in IR25588 than IR58 indicating the higher sink strength in low-tillering with large panicled cultivars than in high-tillering with small panicled cultivars.

Based on the morpho-anatomical characteristics of a low-tillering cultivar and the top six tillers within a plant, the present results could be support that "a low-tillering sturdy culms with large panicles" is an ideotype of rice plant for increasing grain yield potential.

Rice yield has greatly increased in the last two decades mainly through improved rice varieties and cultural practices. Since the release of IR8, in 1966, which started a "green revolution" in rice, the yield potential of rice per crop has reached a plateau[5]. Increasing the number of spikelets and improving grain filling or grain density on a panicle would be increase the yield potential of rice.

Different ideotypes of rice plant are proposed. Morphological characteristics of ideotype of rice plant are generally short and stiff culm, and erect leaves. Yoshida(1972) emphasized high-tillering cultivars and Chandler(1969) claimed low - to medium-tillering cultivars. Recently, Kim and Vergara(1991) suggested a low-tillering plant type with large panicles as an ideotype of rice plant for increasing grain yield potential.

The morpho-anatomical characteristics of pani-

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cles in rice plant is generally correlated with the spikelet differentiation and grain yield per panicle. For the development of large panicles with higher number of spikelets, the vascular bundles play an important role. Generally, the number of inner vascular bundles is closely correlated with the number of primary and secondary rachis-branches and number of spikelets per panicle[6,3]. Pedicellar vascular bundles had a relationship with the carbohydrate supply and absorption, and the ultimate ripening and quality of rice kernel[2].

This study was conducted at the International Rice Research Institute (IRRI) in 1988 to investigate the panicle morphology and peduncle vascular system of different tillers within a plant in low- and high-tillering rices and their relationships on the number of spikelets and grain weight per panicle.

MATERIALS AND METHODS

IR25588-7-3-1, a low-tillering advanced breeding line with large panicles and IR58, a high-tillering cultivar with small panicles were used[11]. Both genotypes have similar plant height (about 88cm) and growth duration (about 103 days) but differ in tillering ability and panicle size. Tillering ability of IR25588 was only 60% that of IR58.

Pregerminated seeds were sown in trays containing Maahas clay soil (*Abdaqueptic Haplaquoll*). One 10-day-old seedling was transplanted per 1/5,000a Wagner pot containing 3.5kg soil, puddled and mixed with 0.9g N, 0.4g phosphorus and 0.5g potassium. Nitrogen was splitted : 50, 20, 20 and 10% at pretransplanting as basal, 2 weeks after transplanting (WAT) for tillering, panicle initiation and heading stage, respectively. Water depth was maintained at 2 to 3 cm.

The experiment was laid out in a completely randomized design with 15 replications per cultivar. Emergence of primary (P), secondary (S) and tertiary (T) tillers were recorded by marking tillers with plastic lables and colored threads every two days. The tillers were labelled M (main culm) ; P1, P2, P3 (1st, 2nd, 3rd primary tillers) ; S1P1, S2P1, S3P1 (1st, 2nd, 3rd secondary tillers orginating from P1 and so on) ; and T1, T2 (1st, 2nd tertiary tillers) developing from the secondary tillers. At heading stage, to observe the vascular bundles about 3-4 cm segments just below the neck node of the panicles were sampled and fixed in the formalin-acetic acid-alcohol solution[8]. The free-hand transverse sections were made and stained with safranin and fast-green, and were observed under a light microscope. At the same time, the spikelet number and the number of primary and secondary rachis-branches on the panicles were counted.

RESULTS AND DISCUSSION

1. Tiller height and panicle length of different tillers

The tiller heights of IR25588 and IR58 were similar, while the panicle length of IR25588 was much longer than that of IR58 (Table 1). Generally, low-tillering cultivars have longer plant height and panicle length compared with high-tillering cultivars.

The tiller height and panicle length of the top six tillers (M, P1, P2, P3, P4 & S1P2) were longer than

Table 1. Tiller height (cm) and panicle length (cm) of different tillers in a plant of IR25588 and IR58.

Tiller	IR25588		IR58	
	Tiller height[1/]	Panicle length	Tiller height[1/]	Panicle length
M*	76±1.2[2/]	27.7±0.3	75±1.2[2/]	23.4±0.4
P1*	72±2.4	26.3±0.7	72±1.3	22.6±0.5
P2*	75±1.0	28.0±0.4	73±1.0	22.7±0.4
P3*	74±0.7	27.3±0.4	71±1.0	23.2±0.4
P4*	72±1.0	26.5±0.4	70±0.8	23.0±0.4
P5	66±1.4	24.2±0.4	66±0.9	20.5±0.5
P6	51±4.5	19.0±0.9	57±1.1	18.9±0.3
S1P1	66±1.7	24.3±0.6	65±1.2	21.3±0.5
S2P1	66±2.0	24.3±0.6	65±1.3	20.6±0.4
S3P1	66±1.4	23.3±0.4	63±1.0	20.0±0.4
S1P2*	70±1.1	27.0±0.5	70±1.0	22.1±0.4
S2P2	66±1.2	24.3±0.6	66±1.2	20.9±0.4
S3P2	59±1.4	22.9±0.5	60±1.0	20.3±0.5
S1P3	66±1.4	23.5±0.5	63±1.3	20.0±0.4
T1S1P1	57±2.8	21.0±0.7	52±2.4	17.7±0.6
T2S1P1	52±3.8	18.6±1.2	43±4.8	16.7±1.8
Mean	65.9	24.3	64.4	20.2

* The top six tillers.

1/ Culm length.

2/ Mean±standard error.

those of the rest of the tillers in both low- and high-tillering cultivars (Table 1). The height of the top six tillers may have an advantage to accumulate more carbohydrates through better utilization of solar energy for photosynthesis as compared with that of the rest of the tillers.

Kim and Vergara (1991) reported that the top six tillers or panicles in both low- and high-tillering cultivars were significantly bigger than that in the other tillers based on spikelet number and grain weight per panicle. The top six tillers were also characterized by earlier initiation and heading, longer growth duration, greater leaf area and heavier culm.

2. Peduncle diameter and thickness

The peduncle diameter and thickness of IR25588 (low-tillering type) were larger than those of IR58 (high-tillering type). In general, the top six tillers had much bigger peduncle diameter than the rest of the tillers in both cultivars (Table 2).

The bigger culms would have more and larger vascular bundles probably indicating a better delivery system. Translocation of metabolites depends on the development of an efficient vascular system. Kaur and Singh (1987) observed that application of growth regulators increased the number of vascular bundles and phloem cross section area and significantly increased the number of spikelets per panicle, percent filled spikelets, 1000-grain weight and grain yield in four rice cultivars.

The peduncle thickness did not vary significantly among tillers of different orders, especially in IR25588. Some tertiary tillers (T1S1P1, T2S1P1) had peduncle thickness similar to that of the top six tillers (Table 2). In IR58, peduncle thickness showed a tendency for thicker peduncles in the top six tillers.

3. Primary and secondary rachis-branches

The number of primary rachis-branches in IR25588 and IR58 were similar within the same tiller or tiller order, whereas that of secondary rachis-branches in IR25588 were always higher than that in IR58. Thus, the total number of rachis-branches of IR25588 was higher than that of IR58 (Table 3). The total number of rachis-branches per panicle decreased with tiller order in both cultivars.

Generally, the top six panicles had more primary rachis-branches than the rest of the panicles except

Table 2. Peduncle diameter (mm) and thickness (mm) of different tillers in IR25588 and IR58.

Tiller	IR25588		IR58	
	Peduncle diameter	Peduncle thickness	Peduncle diameter	Peduncle thickness
M*	2.53±0.12[1/]	0.33±0.03	2.33±0.06[1/]	0.32±0.02
P1*	2.64±0.04	0.33±0.01	2.17±0.08	0.30±0.02
P2*	2.73±0.05	0.36±0.01	2.27±0.12	0.26±0.01
P3*	2.61±0.02	0.36±0.02	2.36±0.11	0.32±0.05
P4*	2.54±0.11	0.32±0.05	2.26±0.09	0.30±0.01
P5	2.03±0.12	0.33±0.02	1.87±0.08	0.26±0.01
P6	1.82±0.14	0.29±0.02	1.71±0.09	0.26±0.02
S1P1	2.43±0.09	0.35±0.01	1.83±0.10	0.26±0.02
S2P1	2.55±0.12	0.35±0.01	1.74±0.10	0.26±0.02
S3P1	2.13±0.19	0.33±0.02	1.59±0.13	0.27±0.06
S1P2*	2.56±0.05	0.35±0.02	2.29±0.11	0.31±0.02
S2P2	2.20±0.10	0.33±0.02	1.74±0.10	0.26±0.02
S3P2	1.90±0.06	0.36±0.02	1.67±0.02	0.26±0.01
S1P3	2.29±0.04	0.35±0.01	1.80±0.06	0.29±0.03
T1S1P1	1.96±0.12	0.35±0.01	1.36±0.07	0.25±0.01
T2S1P1	1.73±0.02	0.33±0.01	1.37±0.12	0.24±0.01
Mean	2.29	0.34	1.90	0.28

* The top six tillers. [1/] Mean±standard error.

Table 3. Number of rachis-branches in a panicle of different tillers in IR25588 and IR58.

Tiller	IR25588			IR58		
	Primary branch	Secondary branch	Total	Primary branch	Secondary branch	Total
M*	11.6±0.2[1]	42.6±1	54.2±1	12.0±0.1[1]	34.0±2	46.0±2
P1*	10.2±0.4	43.4±2	53.6±3	11.2±0.2	32.4±1	43.6±1
P2*	10.8±0.2	48.4±2	59.2±3	10.6±0.2	33.2±1	43.8±2
P3*	10.6±0.4	44.0±3	54.6±3	10.8±0.8	28.6±2	39.4±2
P4*	10.6±0.2	37.4±2	48.0±2	10.6±0.2	31.4±1	42.0±2
P5	9.5±0.2	25.8±4	35.3±4	9.8±0.2	21.4±3	31.2±3
P6	9.3±0.3	19.2±3	28.5±3	9.7±0.2	15.5±3	25.2±4
S1P1	10.2±0.2	31.8±4	42.0±4	9.8±0.3	22.2±3	32.0±3
S2P1	9.8±0.2	31.4±3	41.2±3	9.4±0.2	16.2±3	25.6±3
S3P1	9.8±0.3	28.0±5	37.8±6	8.7±0.3	14.3±4	23.0±4
S1P2*	9.4±0.2	38.0±2	47.4±3	10.2±0.3	30.0±2	40.2±2
S2P2	9.6±0.2	30.0±4	39.6±4	9.4±0.2	16.2±3	25.6±2
S3P2	9.5±0.2	18.0±2	27.5±2	9.3±0.2	13.5±4	22.8±2
S1P3	9.3±0.8	22.7±2	32.0±2	9.4±0.4	18.2±2	27.6±2
T1S1P1	9.2±0.5	21.2±5	30.4±5	7.6±0.2	6.8±1	14.4±1
T2S1P1	8.3±0.3	11.7±1	20.0±1	8.0±0.5	6.7±1	14.7±1
Mean	9.9	30.8	40.7	9.8	21.3	31.1

* The top six tillers. [1] Mean±standard error.

in S1P2 of IR25588, which compensated with more secondary rachis-branches (Table 3). The top six panicles had generally more secondary rachis-branches than the rest of the tillers in both cultivars. Thus, the total number of rachis-branches per panicle was higher in the top six panicles.

4. Number of spikelets

IR25588 (panicle weight type) had more spikelets per panicle than IR58 (panicle number type). The top six panicles had more spikelets per panicle than the rest of the panicles in both cultivars (Table 4).

Spikelet number on primary rachis-branches in IR25588 and IR58 were similar within the same tiller or tiller order, whereas the number of spikelets on secondary rachis-branches in IR25588 was always higher than that in IR58. Thus, the total number of spikelets per panicle in IR25588 was higher than that in IR58. In the both cultivar, the total number of spikelets per panicle was highest in the main culm, followed by that in the primary, secondary and tertiary panicles.

The main contributor to the total number of spikelets per panicle in IR25588 was the spikelets on secondary rachis-branches which contributed 67.3% to the total spikelets per panicle. The low-tillering cultivar need many secondary rachis-branches to compensate for its low panicle number per plant compared with the high-tillering cultivar.

5. Anatomical characteristics

IR25588 had more inner (IVB) and outer vascular bundles (OVB) just below the panicle neck node than IR58 (Table 5). The main culm had the largest number of IVB, followed by the primary, secondary and tertiary tillers in both cultivars. There were variations in the number of IVB within tiller orders in both cultivars. In the primary tillers, P4 and P5 had fewer IVB than P1 and P2. Tillers that emerged later had fewer IVB than tiller that emerged earlier. The number of IVB is probably controlled by tillering time and origin of tillers as well as varieties.

The IVB (large vascular bundles) played an important role in translocation of plant nutrients to the spikelets and influenced the ripening, while OVB (small vascular bundles) entered and terminated in the rudimentary glumes of spikelets[3]. Thus, IVB is more important than OVB on the transport of carbohydrates to the sink.

The number of IVB in peduncle generally de-

Table 4. Number of spikelets on the primary (PB) and secondary rachis-branches (SB) of different tillers in IR25588 and IR58.

Tiller	IR25588			IR58		
	Spikelets on PB	Spikelets on SB	Total	Spikelets on PB	Spikelets on SB	Total
M*	67±1[1/]	180±7	247±7	62±2[1/]	110±4	172±4
P1*	59±3	157±7	216±8	57±2	98±4	155±4
P2*	60±2	185±7	245±7	58±4	111±4	169±5
P3*	63±2	170±7	233±7	54±2	106±5	160±5
P4*	58±2	146±6	204±6	53±2	101±4	154±4
P5	55±1	114±8	169±8	51±2	66±4	117±4
P6	46±4	36±10	82±14	50±1	39±4	89±4
S1P1	58±1	114±11	172±11	52±2	73±5	125±5
S2P1	57±1	115±9	172±9	52±2	63±4	115±4
S3P1	54±1	89±5	143±5	50±2	54±4	104±4
S1P2*	55±2	145±6	200±6	51±2	93±5	144±5
S2P2	56±1	113±7	169±6	49±2	72±4	121±5
S3P2	53±2	71±6	124±6	49±2	47±4	96±4
S1P3	53±2	104±8	157±9	48±1	54±4	102±4
T1S1P1	45±5	45±9	90±11	45±3	23±5	68±7
T2S1P1	43±8	27±8	70±16	43±5	17±6	60±11
Mean	55 (32.7)	113 (67.3)	168 (100)	52 (42.6)	70 (57.4)	122 (100)

* The top six tillers. [1] Mean±standard error. ( ) : %

Table 5. Number of inner (IVB) and outer vascular bundles (OVB) of different tillers in IR25588 and IR58.

Tiller	IR25588		IR58	
	IVB	OVB	IVB	OVB
M*	24.4±0.6[1/]	23.0±1.0	22.0±0.6[1/]	22.0±0.4
P1*	23.6±0.6	24.2±1.1	22.1±0.7	21.8±1.1
P2*	23.2±0.3	24.6±1.2	22.2±0.8	21.2±0.7
P3*	22.0±0.4	23.8±1.2	21.4±0.4	20.2±0.8
P4*	21.2±0.4	23.8±0.9	21.0±0.4	20.6±0.6
P5	21.3±0.4	21.0±1.0	19.2±0.9	19.6±1.3
P6	18.0±0.5	21.0±1.2	18.2±0.2	17.3±1.1
S1P1	21.2±0.7	22.8±0.9	19.0±0.7	18.8±1.3
S2P1	20.4±0.5	23.0±1.0	18.6±0.8	17.6±1.1
S3P1	20.4±0.6	20.8±1.2	17.0±0.8	18.0±1.0
S1P2*	21.2±0.3	23.2±0.9	20.4±0.6	19.8±0.3
S2P2	20.8±0.4	22.2±1.2	18.6±0.9	18.6±0.8
S3P2	20.0±0.9	20.0±1.0	18.0±1.0	17.3±1.7
S1P3	20.3±0.6	20.3±0.8	18.2±1.0	18.2±1.2
T1S1P1	18.6±0.8	18.8±0.4	15.0±0.7	15.0±0.5
T2S1P1	18.2±0.9	18.7±0.6	15.5±0.2	15.0±1.2
Mean	20.9	22.0	19.2	18.8

* The top six tillers. [1/] Mean±standard error.

creased at the rate of two for each tiller order (Table 5). Hayashi (1976 b) observed that the number of IVB decreased at the rate of one per tiller order. There would be varietal differences in the number of IVB in peduncle.

The top six tillers generally had more IVB and OVB than the rest of the tillers in both cultivar. The bigger culms had more vascular bundles probably indicate a better translocation system. Although the capacity of the vascular system may not be the major yield-limiting factor in cereals, it is important in dry matter accumulation[4,14].

Based on the anatomical characteristics of the top six tillers, this result could be support the suggestion of Kim and Vergara (1991) that "a low-tillering sturdy culms with large panicled cultivar" is an ideotype of rice plant for increasing grain yield potential.

6. Correlation between vascular bundles and panicle characteristics

In rice, the morpho-anatomical characteristics of panicle is generally correlated with the differentiation of spikelets and rachis-branches and grain yield per panicle.

The peduncle diameter in IR25588 was highly cor-

Table 6. Correlation analysis between peduncle size and number of vascular bundles in peduncle and panicle characters.

Cultivar	Peduncle(P.) size	IVB[1/]	OVB[2/]	Spikelets per panicle	Panicle weight
IR25588	P. diameter	0.81**	0.92**	0.92**	0.91**
	P. thickness	0.26ns	0.12ns	0.32ns	0.30ns
IR58	P. diameter	0.96**	0.92**	0.96**	0.96**
	P. thickness	0.72**	0.73**	0.74**	0.76**

[1/] IVB : Inner vascular bundle. * Significant at 5% level
[2/] OVB : Outer vascular bundle. ** Significant at 1% level

related with spikelet number and grain weight per panicle, while peduncle thickness showed no correlation(Table 6). In IR58, the peduncle diameter and thickness showed highly significant relationships with the spikelet number and grain weight per panicle, however the correlation coefficients in peduncle diameter were much higher than that in peduncle thickness. This implies that peduncle diameter would be more important than peduncle thickness on the spikelet differentiation and grain yield, especially in low-tillering cultivars.

The correlation coefficients between peduncle

Table 7. Correlation analysis between number of vascular bundle in peduncle and panicle characters.

Cultivar	Vascular bundle	Branch Primary	Branch Secondary	Spikelets per panicle	Fertility	1,000-grain wt.	Panicle wt.
IR25588	IVB[1/]	0.85**	0.88**	0.94**	-0.21ns	0.58*	0.94**
	OVB[2/]	0.77**	0.93**	0.89**	-0.29ns	0.50*	0.88**
IR58	IVB	0.96**	0.97**	0.97**	0.39ns	0.58*	0.96**
	OVB	0.95**	0.97**	0.96**	0.42ns	0.63*	0.96**

[1/] IVB : Inner vascular bundle. * Significant at 5% level
[2/] OVB : Outer vascular bundle. ** Significant at 1% level

Table 8. Number of inner vascular bundle(IVB) per primary branche(PB) and number of spikelets per PB and IVB in different tillers in IR25588 and IR58.

Tiller	IR25588 IVB per PB	IR25588 Spikelets per PB	IR25588 Spikelets per IVB	IR58 IVB per PB	IR58 Spikelets per PB	IR58 Spikelets per IVB
M*	2.1	21.3	10.1	1.8	14.3	7.8
P1*	2.3	21.2	9.2	2.0	13.8	7.0
P2*	2.2	22.7	10.6	2.1	15.9	7.6
P3*	2.1	22.0	10.6	2.0	14.8	7.5
P4*	2.0	19.2	9.6	2.0	14.5	7.3
P5	2.2	17.8	7.9	2.0	11.9	6.1
P6	1.9	8.8	4.6	1.9	9.2	4.9
S1P1	2.1	16.9	8.1	1.9	12.8	6.6
S2P2	2.1	17.6	8.4	2.0	12.2	6.2
S3P1	2.1	14.6	7.0	2.0	12.0	6.1
S1P2*	2.2	21.3	9.4	2.0	14.1	7.1
S2P2	2.2	17.6	8.1	2.0	12.9	6.5
S3P2	2.1	13.1	6.2	1.9	10.3	5.3
S1P3	2.2	16.9	7.7	1.9	10.9	5.6
T1S1P1	2.0	9.8	4.8	2.0	8.9	4.5
T2S1P1	2.2	8.4	3.8	1.9	7.5	3.9
Mean	2.1	16.8	7.9	2.0	12.3	6.3

* The top six tillers.

diameter and the number of IVB or OVB were higher than the coefficients between peduncle thickness and the number of IVB or OVB, especially in IR25588 (Table 6).

The vascular bundle system plays an important role in the translocation of assimilates from source to sink. The number of IVB and OVB were highly correlated with the number of rachis-branches, spikelets per panicle and panicle weight in both IR25588 and IR58, whereas fertility had no correlation (Table 7). Hayashi (1976 a) and Dana et al. (1969) observed similar results. The development of young panicles have a correlation with the histogenesis of the inner vascular bundles[15].

The number of IVB is usually correlated with the number of primary rachis-branches. In this study, around two IVB were anatomically connected to a primary rachis-branch regardless of cultivar and tiller order (Table 8). Joarder and Eunus (1980) and Dana et al. (1969) observed around one and three IVB per primary rachis-branch, respectively. While, Lee et al. (1985) reported a variation depending on the cultivar and nitrogen fertilization.

The number of spikelets per primary branch and spikelets per IVB were higher in IR25588 than IR58 (Table 8). This implies that the sink strength of low-tillering with large panicled cultivars would be higher than that of high-tillering with small panicled cultivars.

摘　要

本 試驗은 벼의 小蘗性과 多蘗性 品種에서 分蘗의 種類에 따른 이삭목節間 (上位第1節間)의 維管束과 이삭의 特性을 조사하고, 이들 相互間의 關聯性을 究明하고자 國際米作硏究所(IRRI)에서 1988年에 遂行하였다. 供試品種은 小蘗·穗重型인 IR25588과 多蘗·穗數型인 IR58이었으며 이들은 分蘗能力과 이삭의 크기는 현저한 差異가 있으나 다른 特性은 비슷하였다.

1. 이삭목節間의 大·小維管束數는 IR25588(小蘗性)이 IR58(多蘗性)보다 많았고 또한 두 品種 모두 "上位6個의 이삭"은 다른 이삭보다 維管束數가 많았는데, 이는 小蘗性品種이 多蘗性品種보다 同化產物의 轉流에 有利한 特性으로 해석된다.
2. IR25588과 IR58間의 穗當穎花數를 보면, 1次枝梗에 있는 穎花數는 서로 비슷하였으나 (IR25588=55개, IR58=52개) 2次枝梗에 있는 穎花數는 IR25588(113개)이 IR58(70개)보다 61.4%나 많았다. 또한, 두 品種 모두 "上位6個의 이삭"은 다른 이삭에 比하여 穗當穎花數가 有意的으로 많았다. 이러한 傾向은 이삭의 枝梗數에서도 비슷하였다.
3. IR25588은 IR58에 比하여, 또 "上位6個의 이삭"은 다른 이삭에 比하여 節間의 굵기와 두께가 컸는데, 이는 小蘗性品種이 多蘗性品種보다 더 많은 維管束을 가지고 있음을 뒷받침하고 있다. 이러한 結果로 미루어, "小蘗·强稈·穗重型"의 벼 品種이 收量性을 現在보다 높일 수 있는 새로운 理想的인 草型으로 思料된다.
4. 이삭목節間의 維管束數는 1次·2次枝梗數, 穗當穎花數, 이삭重과 매우 밀접한 正의 有意相關을 나타내었는데, 이는 節間이 굵은 小蘗性品種이 그에 비례하여 維管束數가 많으며 따라서 枝梗數와 穎花數를 많게하여 이삭重을 增加시키는 것으로 해석된다.
5. 1次枝梗 1個當 穎花數와 大維管束 1個當 穎花數는 IR25588이 IR58보다 많았는데, 이는 小蘗性品種의 sink strength가 多蘗性品種의 그것보다 큰 것으로 思料된다.
6. 分蘗種類에 따른 維管束數는 IR25588과 IR58 모두 主稈>1次分蘗>2次分蘗>3次分蘗의 順으로 많았다.

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