〔韓作誌(Korean J. Crop Sci.) 38(2) : 103~111(1993)〕

Determination of the Optimum Tillers in Different Rice Cultivars for High Yield

Jae Duk Kim* and Benito S. Vergara**

多收穫을 위한 벼品種群別 適正 分蘖莖數의 決定

金 在 德*, 비 에스 베가라**

ABSTRACT : A greenhouse experiment was conducted to determine the number of optimum tillers within a plant for high yield and to clarify the morpho-anatomical characteristics of cultivars having different tillering abilities. Optimum tillers, i.e tillers which produced heavy panicles were found to be around five to nine tillers per plant, although wider range may be possible if more cultivars were tested or under different growth conditions. Optimum tillers emerged within a short time after transplanting as compared with the other tillers. They exhibited longer tiller duration, produced more spikelets and had better filled spikelets, more vascular bundles and were taller with larger leaf area. However, the 1,000 grain weight and fertility varied with cultivars and showed no general trend. Of this morpho-anatomical features, the total number of spikelets per plant was considered as the potential criterion for determining the optimum tiller number.

Introduction

Tillering ability differs with cultivars and environment, and each tiller shows a different capacity to produce the grain yield. In transplanted rice culture, the panicle number per unit area largely depends on rice tillering ability. The main culm within a plant is the heaviest and largest panicle followed by the primary, secondary and tertiary tillers.[5,6] Nowadays, high-tillering cultivars are widely used where transplanting is common, while direct-seeding is practiced. However, under normal tropical conditions, an increase in panicle number per unit area or within a hill reduces the number of spikelets per panicle and vice versa.[2)]

On the other hand, low tillering cultivars had a shorter tillering period and a higher percentage of effective tillers than the high tillering variety.[4)] Based on spikelet number and panicle weight per tiller, Kim[3)] identified the top six tillers which had both the highest spikelet number and panicle weight but also had earlier emergence and heading dates.

Although environment and cultural management greatly influences the number of tillers produced different tillering capacity is inherent in rice. Since tiller size and hence panicle size within a plant vary greatly, the number of top or high yielding tillers per plant probably differs among cultivars.

This study was conducted at International Rice Research Institute in order to identify

* 農村振興廳 熱帶農業官室(International Technical Cooperation Center, Rural Development Administration)
** 國際米作硏究所(International Rice Research Institute, P.O.Box 933, Manila philippines) 〈92. 4. 13 接受〉

the optimum number of tillers in various cultivars and to investigate the morpho-anatomical characteristics of optimum and other types of tillers during the 1989 dry season.

Materials and Methods

Rice cultivars having different tillering abilities were used in the greenhouse of IRRI (Table 1). One 10 day-old seedling was transplanted into a 4 liter plastic pot (1/5,000a) and was mixed with 4g ammonium sulfate (21%N) and 2g each solophos(18% P_2O_5) and murate of potash(60% K_2O). The experimental design was randomized complete block with 18 replications for tillering patterns and yield contributions of different tillering patterns and yield contributions of different tiller orders and 8 replications for assessment of anatomical differences.

Date of emergence of primary, seconday and tertiary tillers were noted using plastic labels with colored threads everyday. Heading date of panicle indicated everyday as each panicle was 1/3 exerted from the flag leaf sheath. For anatomical assessment, 2 to 3cm internode including the peduncle was sampled and free-hand transverse sections were made. The sections were observed under a light microscope at 40× magnification to determine the number and size of vascular bundles(VB). Peduncle diameter and thickness were also measured. Plants were harvested 30 days after heading and oven dried at 70℃ for 3 days. Plant height, panicle length, panicle characteritics, and yield component were measured from optimum tiller and the other tillers. The optimum tillers were selected by spikelet number per panicle that did not differ significantly($p=0.05$) among the tillers within their hill.

Table 1. General morphological characters of entry plant materials.

Group	Entry	Tillering ability	No. of tillers	Plant hight
Indica	IR30	High	22	Short
Indica	IR47705 [1]	Low	8	Tall
Indica	Rewa	Low	8	Tall
Japonica	Unbong [2]	Moderate	11	Short
Javanica	Silewah	Low	8	Tall
Tongil	M83 [3]	Moderate	14	Short
Hybrid	Hybrid [4]	Moderate	14	Tall

[1] IR47705-AC5 [2] Unbongbyeo
[3] Milyang83 [4]IR30/IR47705

Results and Discussions

1. Morphological Characters for Optimum Tillers

Spikelet number in rice indicates the potential for grain yield per unit area, per hill or per tiller and was therefore chosen as the criteria to determine the optimum tiller(OT). All the top tillers, irrespective of there order, that did not differ significantly($p=0.05$) in spikelet number(i.e. yield potential) were considered as optimum tillers. The OT for different cultivars are presented in Fig. 1 and Table 2 which showed that the optimum tiller number(OTN) was around five to nine tillers. This agrees more or less with Kim's(1988) report although wider range may be possible with more cultivars tested or under different growing conditions. It can be seen from the table 2 that IR30 and M83 have the highest number of eight or nine optimum tillers, respectively, whereas Hybrid and Silewah had the lowest OTN of five. Other cultivars had six to seven OTN.

In general the OT included main culm(M) and P1(primary tiller 1) to P4 tiller however, in Rewa P5 rather than P3 was included in the top five OT while in Unbongbyeo(Unbong), it was P1S1 rather than P4. These observations indicated that later tiller orders initiated earlier can overtake and exceed the high tiller order in growth. This phenomenon appears to be rather common as shown from Fig. 1 and Table 2, and reflects the intraplant deviation in tiller development. The M in Hybrid exceptionally produced fewer spikelets

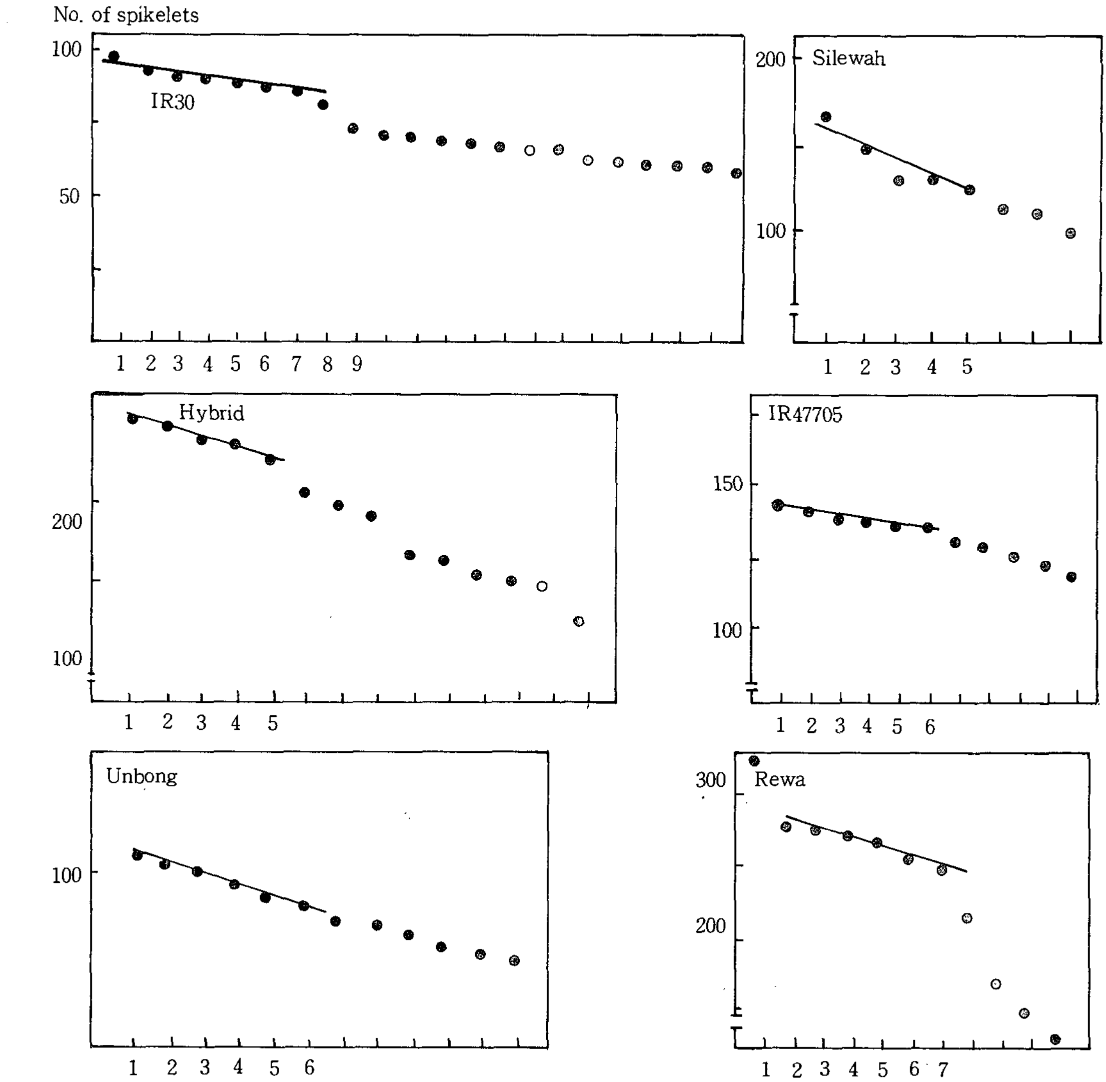

Fig. 1. Variation of spikelet number per panicle on different tillers in IR30, IR47705, Rewa, Silewah, Hybrid and Unbongbyeo.

than P2 and P1. In another study, Kim[3] identified the top six tillers(M, P1 to P4 and P2S1) as the optimum tillers. Meanwhile filled spikelet weight per panicle on different tillers of a plant showed similar trends with the number of spikelet per panicle. This result indicates that the number of spikelet per panicle was the most important factor which affect the grain yield(Table 3). Rewa showed the highest filled spikelet weight(FSW) in main culm and followed by Hybrid and IR47705 while IR30 had the lowest FSW.

The tillering behavior of the six cultivars studied for tillering potential were shown in figure 1. IR47705 and Unbong showed a continuous decline while IR30, Rewa and Hybrid showed an abrupt drop in spikelet number per panicle from OTN down to the rest of the tillers.

The data on the number of days to tiller in-

Table 2. Position of optimum tillers based on spikelet number within a hill of different types of cultivars.

Group	Cultivars	No. of tillers		Optimum Tillers									Regression and Correlation
		Mean	Optimum	1	2	3	4	5	6	7	8	9	
Indica	IR30	22	8	M	P1	P2	P3	P4	P5	P6	S1P1		y= 93.4−1.61x r=−0.917**
	IR47705	11	6	M	P2	P3	P1	P4	P5				y=138.6−3.47x r=−0.899*
	Rewa	11	7	M	P1	P2	P5	P4	P3	S2P1			y=285.5−7.18x r=−0.935**
Japonica	Unbong	11	6	M	P1	P2	P3	S1P1	S2P1	S2P1			y=114.8−5.89x r=−0.996**
Tongil*	M83	14	9	M	P2	P1	P4	P3	P5		P6	S1P1	y=183.2−6.09x r=−0.973**
Javanica	Silewah	8	5	M	P1	P3	P2	P4					y=145.3−5.28x r=−0.916*
Hybrid	IR30/IR47705	14	5	P2	P1	M	P3	P4					y=248.6−5.65x r=−0.972**

* Indica × Japonica

M=Main culm
P=Primary tiller
S=Secondary tiller

Table 3. Variation of filled spikelet weight(gr.) per panicle on different tillers of a plant in seven rice cultivars.

Tiller Orders	IR30	M83	Hybrid	Unbong	Rewa	IR47705	Silewah
M	1.71a	2.58 a	4.57 ab	2.36 a	6.50 a	3.71 a	2.52 a
P1	1.59 ab	2.10 a−c	4.85 a	2.24 ab	5.05 b	3.28 ab	2.32 ab
P2	1.43 a−d	2.24 ab	4.75 ab	2.27 ab	4.64 b	3.10 bc	2.10 ab
P3	1.49 a−c	2.08 a−c	4.60 ab	2.15 ab	5.07 b	3.30 a−c	2.18 ab
P4	1.41 a−d	2.06 a−c	4.25 bc	1.64 bc	4.96 b	3.19 a−c	2.08 ab
P5	1.42 a−d	2.02 a−d	3.91 cd	−	4.97 b	3.10 bc	1.90 ab
P6	1.38 a−e	1.81 a−d	2.67 g		−	3.07 bc	−
P7	1.20 b−g	−	−			−	
P1S1	1.26 b−f	1.71 a−e	3.72 c−e	1.91 a−c	4.25 b	2.83 b−d	1.87 b
P1S2	1.10 d−g	1.78 a−d	3.37 d−f	1.84 a−c	4.08 bc	2.62 cd	1.80 b
P1S3	1.12 d−g	1.40 c−f	3.16 fg	1.31 cd	2.72 d	−	−
P1S4	1.08 d−g	−	−	−	−		
P2S1	1.12 d−g	1.54 b−e	3.89 c−e	1.51 bc	3.24 cd	2.02 cd	
P2S2	1.06 e−g	1.60 b−e	3.35 ef	1.25 d	−	−	
P2S3	1.00 fg	−	3.06 fg	−			
P2S4	0.96 fg		−				
P3S1	0.95 fg	1.23 d−g	3.13 fg	1.20 d	2.45 d	2.62 d	
P3S2	0.98 fg	−	−	−		−	
P3S3	1.17 c−g						
P4S1	1.03 fg	1.10 e−g					
P4S2	1.10 d−g						
P5S1	0.97 fg						

M : Main culm P : Primary S : Secondary
Treatment means having a same letter are not significantly different by DMRT, 5% level.

itiation and heading of the optimum tillers and the lesser productive tillers were shown in Table 4. In all cultivars, the average number days from transplanting to tillering in the optimum tilleres were 26 to 36 days while the other tillers were 35 to 48 days. The optimum tillers typically emerged over a shorter time after transplanting compared with the orders which were formed later. The differences of heading dates between OTN and the other tillers were 7 to 11 days, which showed more uniform heading. While heading dates were more synchronous than tillering dates, early formed optimum tillers showed longer growth duration than the others. It also appears from the results that in cultivars with long growth duration(days from initiation to heading) e.g. Silewah and Hybrid, optimum tillers had short heading duration of two(e.g. Silewah) to five(e.g. IR30) days with the exception of Unbong, a japonica cultivar which was grown under tropical area.

Table 4. Days to initial tillering and heading after germination, and growth duration of optimum tillers versus lesser tillers in seven rice cultivars.

Cultivar	Tiller order	Days to initial tillering	Days to heading	Growth duration** (Day)
IR30	Optimum	29.0 ± 6.3	78.1 ± 1.3	48.6 ± 5.2
	Others*	40.3 ± 7.0	82.4 ± 3.5	41.4 ± 4.5
M83	Optimum	28.5 ± 5.7	72.1 ± 0.8	44.1 ± 5.4
	Others	36.2 ± 3.1	74.4 ± 2.1	38.1 ± 1.9
Hybrid	Optimum	26.3 ± 4.5	80.8 ± 0.5	54.5 ± 4.8
	Others	35.5 ± 4.5	81.5 ± 0.9	46.0 ± 3.8
Unbong	Optimum	36.2 ± 6.8	58.0 ± 2.8	22.6 ± 4.1
	Others	47.7 ± 3.8	64.3 ± 2.7	16.0 ± 2.6
IR47705	Optimum	29.4 ± 5.3	96.4 ± 1.3	67.0 ± 6.3
	Others	37.1 ± 3.3	95.6 ± 3.3	58.7 ± 5.4
Rewa	Optimum	31.0 ± 5.6	71.7 ± 1.4	40.7 ± 5.1
	Others	39.5 ± 6.0	74.8 ± 2.5	35.3 ± 3.7
Silewah	Optimum	26.3 ± 5.1	81.8 ± 0.5	55.5 ± 5.4
	Others	35.3 ± 3.9	80.4 ± 1.0	45.1 ± 3.4

* Lesser tillers which occurred in at least 50 percent of the sampled plants.
** Duration of tillers from initiation to heading. Mean ± standard deviation

The observed longer growing duration of optimum tiller is probably important in the prodution of longer panicles and better spikelet filling. Result of present study(Table 5) strengthened this contention.

The optimum tillers produced significantly higher number of spikelets than other tillers, which ranged from 22(or 17% greater than other tillers) in IR47705 to 95(or 35% greater than other tillers) in Rewa(Table 5). Similarly optimum tillers produced a higher filled spikelet number than the other tillers. However, the fertility and 1000-grain weight of optimum tillers and the other tillers varied with cultivars and showed no general trend. M83 and Unbong had higher fertility in the optimum tillers compared with the other tillers.

Table 5. Yield and yield components of different tiller orders in seven rice cultivars.

Cultivar	Tiller order	No. spikelet /panicle	Fertility (%)	1000-grain weight(g)	No. filled spikelet/panicle	Wt. grains /panicle(g)
IR30	Optimum	86 ± 1.6*	87.4 ± 0.8	19.00 ± 0.32	76 ± 1.49	1.43 ± 0.03
	Others	65 ± 1.4	87.7 ± 0.5	18.43 ± 0.11	57 ± 1.18	1.04 ± 0.02
M83	Optimum	154 ± 4.4	85.0 ± 1.5	16.15 ± 0.18	130 ± 3.73	2.05 ± 0.05
	Others	105 ± 3.7	78.7 ± 1.6	16.11 ± 0.21	84 ± 4.28	1.33 ± 0.06
Hybrid	Optimum	231 ± 4.1	81.8 ± 0.7	24.39 ± 0.13	189 ± 3.39	4.59 ± 0.08
	Others	173 ± 3.7	84.2 ± 0.6	23.97 ± 0.12	145 ± 2.96	3.47 ± 0.07
Unbong	Optimum	92 ± 2.2	91.5 ± 1.0	24.47 ± 0.27	94 ± 1.46	2.11 ± 0.09
	Others	66 ± 1.9	87.3 ± 2.8	24.79 ± 0.57	62 ± 1.40	1.49 ± 0.16
Rewa	Optimum	271 ± 5.3	81.7 ± 1.0	23.06 ± 0.31	222 ± 5.28	5.08 ± 0.12
	Others	176 ± 11.0	81.4 ± 2.0	23.53 ± 0.68	146 ± 9.80	3.42 ± 0.22
IR47705	Optimum	126 ± 2.8	89.1 ± 0.8	29.19 ± 0.16	112 ± 2.46	3.27 ± 0.07
	Others	104 ± 2.6	89.9 ± 1.0	29.27 ± 0.13	94 ± 2.32	2.74 ± 0.07
Silewah	Optimum	141 ± 3.7	56.6 ± 1.8	28.52 ± 0.15	80 ± 3.24	2.26 ± 0.09
	Others	110 ± 4.2	58.5 ± 2.1	29.31 ± 0.16	64 ± 3.07	1.86 ± 0.09

* Mean ± standard error

A comparison of morphological and growth related traits for optimum and the other tillers are presented in Table 6. The optimum tillers formed first and had longer growing duration. They had competitive advantage over others and thus had greater plant height, leaf area, panicle length and more primary branch(PB) as well as secondary branch(SB) per panicle. The leaf area differences between tillers were relatively large in some cultivars such as M83, Hybrid, Rewa, IR47705 and Silewah. Rewa and Silewah also had large leaf area per tiller. The Hybrid and Silewah had the highest number of primary branches in the panicle.

In general, a nonsignificant assosiation was found between tiller duration and days to heading for optimum tillers except Unbong (Table 7). This apparently is due to the fact that optimum tillers emerged earlier in all cultivars except Unbong but the heading of optimum tillers occurred independentely of their initiation dates as can be seen in Fig. 1 and Table 4.

Tiller duration and number of PB and SB was invariably correlated however the number of spikelet per panicle and filled spikelet weight were significant correlation with tiller duration(Table 7). This indicates that if tiller duration was short, panicles were shorter, had fewer PB and SB and fewer spikelets on them. This explains the lower panicle weight for other tillers relative to optimum tillers and, also the positive relationship between the tillering duration and the panicle weight. More often tiller duration had a significant and positive relationship with PB number and spikelet number on PB than it had with SB number and spikelet number on SB. This was true for both tiller groups. This indicates that, in gerneral, cultivars having longer tiller duration had higher number of spikelets per panicle. A notable exception to this relationship was Hybrid for which these correlation were nonsignificant. If there is a need for more PB and more spikelet on the PB as suggested by Vergara,[7] then the optimum tillers satisfy these conditions.

2. Anatomical Chracters of Optimum tillers

Since different tiller orders support different tiller and grain mass, they may differ in

Table 6. Comparison of morphological differences of some plant growth characters in different tiller orders of seven rice cultivars.

Cultivar	Tiller order	No. of tillers	Plant height(cm)	Panicle length(cm)	Leaf area (cm² /tiller)	No. of branch /panicle	
						Primary	Secondary
IR30	Optimum	8	79.3 ± 0.6	21.1 ± 0.18	136 ± 3.1	10.0 ± 0.61	13.3 ± 0.39
	Others	14	69.4 ± 0.8	18.7 ± 0.22	130 ± 2.3	8.4 ± 0.11	9.1 ± 0.31
M83	Optimum	9	79.4 ± 0.9	18.3 ± 0.26	214 ± 7.7	11.4 ± 0.11	27.5 ± 1.00
	Others	5	68.2 ± 1.7	15.9 ± 0.33	163 ± 7.0	9.8 ± 0.19	17.0 ± 1.27
Hybrid	Optimum	5	174.7 ± 1.6	32.6 ± 0.28	218 ± 6.6	15.9 ± 0.20	37.8 ± 0.87
	Others	9	158.7 ± 2.0	29.4 ± 0.40	166 ± 5.2	13.8 ± 0.17	26.8 ± 0.75
Unbong	Optimum	6	73.2 ± 1.0	20.1 ± 0.20	66 ± 4.9	8.1 ± 0.11	16.4 ± 0.36
	Others	5	62.8 ± 1.2	17.4 ± 0.30	42 ± 2.6	6.7 ± 0.08	9.9 ± 0.32
Rewa	Optimum	7	168.7 ± 1.6	34.0 ± 0.36	363 ± 11.6	12.5 ± 0.11	52.7 ± 1.13
	Others	4	156.0 ± 5.2	31.5 ± 0.92	298 ± 20.7	11.1 ± 0.29	33.2 ± 2.45
IR47705	Optimum	6	146.9 ± 1.9	30.9 ± 0.52	282 ± 10.1	14.0 ± 0.18	14.9 ± 0.59
	Others	5	142.2 ± 1.9	29.2 ± 0.55	240 ± 9.7	12.7 ± 0.26	10.9 ± 0.48
Silewah	Optimum	5	195.1 ± 2.5	30.5 ± 0.77	291 ± 11.0	14.5 ± 0.18	25.7 ± 0.85
	Others	8	189.8 ± 4.4	29.2 ± 0.81	221 ± 11.0	12.5 ± 0.23	20.1 ± 0.97
Average	Optimum		131.0	26.6	224.3	11.3	26.9
	Others		121.0	24.7	180.0	9.9	18.1

* Mean ± standard error

Table 7. Correlation analysis between tiller duration and morphological panicle characters in tillers orders of seven rice cultivars.

Cultivar	Tiller order	Dates to heading	Branch No. /panicle		Spikelet No. /panicle			Filled spikelet weight
			PB	SB	Total	PB	SB	
IR30	Optimum	NS	−NS	−NS	**	**	*	**
	Others	−**	*	NS	*	*	NS	NS
M83	Optimum	−NS	**	**	*	*	*	**
	Others	−NS	NS	NS	NS	NS	NS	−NS
Hybrid	Optimum	NS	NS	NS	NS	NS	−NS	NS
	Others	−NS	NS	NS	NS	*	NS	NS
Unbong	Optimum	−**	**	NS	**	**	**	**
	Others	−**	NS	NS	**	NS	−**	NS
Rewa	Optimum	NS	*	*	**	NS	*	**
	Others	−**	NS	−**	*	**	*	*
IR47705	Optimum	NS	*	*	*	NS	*	**
	Others	−NS	−NS	−NS	−NS	−NS	−NS	−NS
Silewah	Optimum	NS	*	**	**	**	**	**
	Others	−NS	NS	NS	NS	NS	NS	−NS

PB : Primary branch
SB : Secondary branch

Table 8. Varietal differences in size and thickness of peduncle and number of vascular bundles for different tiller orders in seven rice cultivars.

Cultivar	Peduncle diameter (mm)		Peduncle thickness** (mm)		Inner vascular bundle(no.)		Outer vascular bundle(no.)	
	Optimum tiller	Other tillers	Optimum tiller	Other tillers	Optimum tiller	Other tillers	Optimum tiller	Other tillers
IR30	1.77 ± .02*	1.55 ± .02	.265 ± .003	.244 ± .003	22.2 ± .27	19.8 ± .25	19.4 ± .25	17.4 ± .27
M83	2.01 ± .04	1.74 ± .03	.307 ± .004	.293 ± .005	21.3 ± .41	17.8 ± .46	20.5 ± .31	18.0 ± .30
Hybrid	2.31 ± .04	1.93 ± .04	.358 ± .005	.307 ± .006	28.7 ± .37	25.0 ± .40	25.9 ± .37	22.6 ± .41
Unbong	1.33 ± .03	1.12 ± .02	.316 ± .003	.228 ± .002	9.0 ± .23	8.1 ± .11	17.0 ± .30	14.8 ± .33
Rewa	2.50 ± .03	2.00 ± .10	.344 ± .007	.308 ± .015	26.7 ± .43	21.1 ± 1.22	22.5 ± .42	18.7 ± .89
IR47705	2.19 ± .03	1.97 ± .04	.398 ± .006	.382 ± .011	22.2 ± .34	20.3 ± .50	30.0 ± .52	27.7 ± .58
Silewah	1.95 ± .03	1.78 ± .05	.357 ± .006	.346 ± .010	27.1 ± .32	15.9 ± .43	29.4 ± .60	24.4 ± .63

* Mean ± standard error
** Peduncle diameter − medullary cavity

the size and organization of these vascular system. The anatomical characters of the optimum tillers were therefore investigated with particular emphasis on the number and size of vascular bundles.

Mean peduncle diameter and peduncle thickness(PTK) for optimum tillers and other tillers for the cultivars used is given in Table 8. Rewa had the highest peduncle diameter 2.50mm, while Unbong had the lowest, 1.33 mm. However, IR47705 had the highest PTK, 0.04mm, whereas Unbong had the lowest value of 0.23mm. The peduncle diameter and thickness based on all tillers for different cultivars had a highly significant relationship (r=0.88**). Within cultivars, correlation between peduncle diameter and thickness was significant. However in IR47705, and Silewah, peduncle diameter and PTK of optimum and other tillers varied independently of each other. All cultivars showed a significant correlation between peduncle diameter and FSW while PTK was correlated with FSW in all cultivars except IR47705 and Silewah(Table 9). Thus, peduncle diameter appears to be of greater importance than PTK. This would be expected if greater peduncle diameter was associated with a more extensive and efficient vascular system. Kim[3] reported that the top six tillers showed bigger culm diameter than the rest of the tillers.

Present results(Table 9) show that peduncle diameter had a highly significant relationship with the number of inner vascular bundle(IVB) as well as outer vascular bundle(OVB) in all cultivars. In turn, the FSW was highly significantly correlated with the number of IVB and OVB in all cultivars. These relationships indicate the role of the number of IVB as important determinants of FSW per panicle which is apparently promoted through allowing adequate flow of crabohydrates from source to the sink. These results also indicate that the size of vascular system as measured by the number of IVB and OVB could be assessed from the much more easily measured peduncle diameter.

There was varietal differences between PTK and number of VB. Cultivars having bigger PTK showed nonsignificant difference between both, while other cultivars having small PTK had significant relationship between number of VB and PTK in optimum tillers except IR47705 and Silewah which produced less number of VB compare to PTK. This result indicates that the optimum tillers of those cultivars have enough size of PTK to produce number of IVB and OVB. Especially, some cultivars such as Hybrid and Unbong showed independent relationship between IVB and OVB. IVB are important because of their much larger size relative to OVB. Actually, OVB are so small that reliable estimates of the size could not be obtained and probaly have little significance in transport of carbohydrates to the sink. Chaudhry and Nagato[1] suggested that IVB played a major role in translocation of plant nutrients to the spikelets and influenced the ripening whereas OVB entered and tern the rudimentary glumes of spikelet.

Table 9. Correlation between filled spikelet weight, and number and size of vascular bundle in seven rice cultivars.

Cultivar	Inner vascular bundle	Outer vascular bundle	Peduncle diameter	Peduncle thickness
IR30	0.80**	0.84**	0.89**	0.69**
M83	0.81**	0.87**	0.87**	0.58**
Hybrid	0.93**	0.93**	0.94**	0.85**
Unbong	0.55**	0.58**	0.68**	0.64**
Rewa	0.84**	0.84**	0.93**	0.75*
IR47705	0.92**	0.91**	0.95**	0.47NS
Silewah	0.79*	0.93**	0.82*	0.70NS

* Significant at the 5% level
** Significant at the 1% level

摘　　要

多收穫을 위한 水稻 適正分蘗莖數의 決定과 그들의 解剖形態學的 特性을 檢討하기 위해 分蘗力이 다른 7個 品種을 供試하여 國際米作硏究所(IRRI) 溫室에서 實驗을 實施하였다.

1. 株當 適正分蘗莖數는 品種에 따라 5~9個로 主稈, 1次 分蘗莖중 1~5번째와 2次 分蘗莖의 1~2번째가 包含되었으며 品種群別 多少의 差가 있었다.
2. 適正分蘗莖은 移秧後 分蘗이 빠르고 營養生長期間이 길며 穗當粒數가 많고 登熱率은 높았으나 1,000粒重은 일정한 傾向이 없었다.
3. 適正分蘗莖의 營養生長期間은 出穗時期와 相關이 없었으나(雲峰벼 除外) 이삭의 1次 枝莖數(IR 30, Hybrid 除外), 充實粒數(Hybrid 除外)과 각각 正의 相關이 認定되었다.
4. 適正分蘗莖은 이삭목의 維管束數가 其他 分蘗莖보다 많았으며 이삭목의 크기와 維管束數 間에 正의 相關關係가 있었다.
5. 이삭목의 數와 크기는 品種間 差가 顯著하였으며 充實粒重은 各 品種 모두 維管束數 및 크기와 正의 相關이 있었다.

Literature Cited

1. Chaudhry, F. M., and K. Nagato. 1970.

Role of vascular bundles in ripening of rice kernel in relation to the location on panicle. Proc. Crop Sci. Japan. 39 : 301－309.

2. IRRI. 1968. International Rice Research Institute, Annual Report for 1968. Los Banos, Laguna Philippines. 402 p.
3. Kim, J. K. 1988. Physiological studies on low tillering rice. An ideotype for increasing grain yield potential. PhD. thesis. Univ. Philip. Los Banos Philippines. 187 p.
4. Kim, J. K., and B. S. Vergara. 1990. Tillering behavior of low and high tilliering rice. Korean J. Crop Sci. 35 : 512－517
5. Mahapatra, I. C., and A. C. Sharma. 1970. Studies on the growth and development of rice plant. II Riso 19 : 55－72
6. Majumder, D. K. 1976. Emergence of tillers, yield and yield components of mother, primary, secondary and tertiary tillers of rice variety TN1 and effect of fertilizer combination there on. J. Res. Viswa Bharati(India) 1 : 37－41
7. Vergara, B. S. 1987. Raising the yield potential of rice. 9th Annual Scientific Meeting of the National Academy of Science and Technology, Philippines International Convention Center, July 15th 1987.