

# Analysis of the Sequence of Flowering in Rice

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Received 3.8.56.

MUCH EMPHASIS is placed on the tillering capacity of rice varieties as the number of panicle-bearing tillers is a yield component. Katayama (1931) observed that as the tillering locus ascends, the length and weight of the panicle decrease rather regularly. Sarvayya (1932) showed that there was a significant negative correlation between the yield per tiller and the number of tillers per plant. Ramiah and Narasimham (1936) found that the main culm made the most marked contribution to yield. The removal of the 2nd and 3rd tillers did not strikingly depress yield. Kanda and Kakizaki (1953) demonstrated an inverse relation between tiller number and both panicle weight and grain number per panicle. Iso (1946) showed that within varieties the correlation coefficients were clearly negative for the relation between the number of tillers and panicle attributes such as panicle length and weight, grain number per panicle and grains per unit length. Narasingha Rao (1937) reported that the number of tillers bore a very high positive correlation with yield, followed by the number of grains per panicle and the length of panicle. He claimed that prolific tillering can reduce panicle length and the number of grains

per panicle, and that it is not possible to increase the tillering indefinitely without depressing the yield.

## Flowering Sequence and Panicle Characters

This paper presents an analysis of the contribution made by successive tillers to yield. The strikingly high correlation between flowering order and tillering order permits the use of the former as an estimate of the latter.

A pure-breeding material of the variety *Panniti* was transplanted in rows at a uniform spacing of 7 by 7 inches at Peradeniya. In the 50 plants of the middle row of a 3-row plot the emergence of panicles of each individual plant was recorded. The measurements of fifteen random individuals were used for calculating the correlation coefficients of the following characters with the sequence of flowering:—

- Length of panicle
- Weight of panicle
- Number of grains per panicle
- 100-grain weight

The frequency distribution of the correlation coefficients are given in Table 1.

TABLE 1—Correlation of Flowering Sequence of Tiller with Panicle Attributes

Class Intervals of $r$	Length of Panicle				Weight of Panicle				No. of grains per Panicle				100—grain weight			
	Tiller No. in class				Tiller No. in class				Tiller No. in class				Tiller No. in class			
	6	7	8	Total	6	7	8	Total	6	7	8	Total	6	7	8	Total
0.99 to +																
0.89 to +																
0.79 to +																
0.69 to +																
0.59 to +																
0.49 to +																
0.39 to +																
0.29 to +																
0.19 to +																
0.09 to +																
0.00 to -																
0.10 to -																
0.20 to -																
0.30 to -																
0.40 to -																
0.50 to -																
0.60 to -																
0.70 to -																
0.80 to -																
0.90 to -																

\* Significant at 5 per cent. point.

A negative correlation clearly exists between panicle order and the length, weight and number of grains per panicle and the 100-grain weight. The correlation coefficients are of considerable magnitude except in the instance of the 100-grain weight. Significance at 5 per cent. point was indicated particularly at the higher tiller numbers. In the instance of the 100-grain weight the correlation is not only low but reaches significance only in two instances.

### Correlation of Flowering Sequence with Panicle Weight

The relation of flowering sequence to panicle weight was the subject of more detailed study on account of its importance in determining yield. For the purpose of this study a larger number of random individuals were used from the original material and the data grouped into classes with plants having the same number of tillers. The figures arranged in correlation tables are given in Table 2.

TABLE 2.—Correlation Tables of Panicle Weight and Flowering Order

*5—Tiller Class*

Flowering order <i>x</i>	Panicle weight gm. <i>y</i>						Row frequency	Total weight	Mean weight
	1	2	3	4	5	6			
1	1		2	3	1		7	24	3.4
2			1	5	1		7	28	4.0
3	1	2	2	2			7	19	2.7
4		3	1	3			7	21	3.0
5	2	2	3				7	15	2.1
Column frequency	4	7	9	13	2		35	—	—

*6—Tiller Class*

Flowering order <i>x</i>	Panicle weight gm. <i>y</i>						Row frequency	Total weight	Mean weight
	1	2	3	4	5	6			
1				2		1	3	14	4.7
2			1	1		1	3	13	4.3
3			3				3	9	3.0
4			2		1		3	11	3.7
5		1	1	1			3	9	3.0
6		2		1			3	8	2.7
Column frequency		3	7	5	1	2	18	—	—

## 7—Tiller Class

Flowering order <i>x</i>	Panicle weight gm. <i>y</i>						Row frequency	Total weight	Mean weight		
	1	2	3	4	5	6					
1	..		2	3	1	..	6	..	23	..	3.8
2	..		1	5		..	6	..	23	..	3.8
3	..		2	3	1	..	6	..	23	..	3.8
4	..	1	1	3	1	..	6	..	16	..	2.7
5	..	2	1	2	1	..	6	..	14	..	2.3
6	..	1	2	3		..	6	..	14	..	2.3
7	..	3	2	1		..	6	..	10	..	1.7
Column frequency	7	6	14	13	2		42				

## 8—Tiller Class

Flowering order <i>x</i>	Panicle weight gm. <i>y</i>						Row frequency	Total weight	Mean weight			
	1	2	3	4	5	6						
1	..			4	1	..	5	..	21	..	4.2	
2	..			3	1	1	..	5	..	23	..	4.6
3	..		1	3	1	..	5	..	20	..	4.0	
4	..	2	1	2		..	5	..	15	..	3.0	
5	..	2	3			..	5	..	13	..	2.6	
6	..	1	4			..	5	..	14	..	2.8	
7	..	4	1			..	5	..	11	..	2.2	
8	..	2	3			..	5	..	8	..	1.6	
Column frequency	2	12	10	12	3	1	40					

## 9—Tiller Class

Flowering order <i>x</i>	Panicle weight gm. <i>y</i>						Row frequency	Total weight	Mean weight			
	1	2	3	4	5	6						
1	..				3	..	3	..	15	..	5.0	
2	..	2				1	..	3	..	10	..	3.3
3	..			1	2		..	3	..	14	..	4.7
4	..			2	1		..	3	..	13	..	4.3
5	..		1	2			..	3	..	11	..	3.7
6	..	1	2				..	3	..	8	..	2.7
7	..		1	2			..	3	..	11	..	3.7
8	..	2			1		..	3	..	9	..	3.0
9	..	1	1	1			..	3	..	6	..	2.0
Column frequency	1	6	5	7	7	1	27	—	—	—	—	

## 10—Tiller Class

Flowering order <i>x</i>	Panicle weight gm. <i>y</i>						Row frequency	Total weight	Mean weight			
	1	2	3	4	5	6						
1	..			1	1		..	2	..	9	..	4.5
2	..			2			..	2	..	8	..	4.0
3	..			1	1		..	2	..	9	..	4.5
4	..			2			..	2	..	8	..	4.0
5	..			2			..	2	..	8	..	4.0
6	..		2				..	2	..	6	..	3.0
7	..	1		1			..	2	..	6	..	3.0
8	..	1	1				..	2	..	3	..	1.5
9	..	2					..	2	..	4	..	2.0
10	..	1	1				..	2	..	3	..	1.5
Column frequency	2	5	2	9	2		20	—	—	—	—	

The regression coefficients of the mean weight of panicles and the order of flowering are given in Table 3 and the regression lines fitted to the data are shown in Figure 1.

TABLE 3—Regression Coefficients of the Mean Weight of Panicles and the Order of Flowering

Tiller class		b
5	..	— 0.4
6	..	— 0.4
7	..	— 0.4
8	..	— 0.4
9	..	— 0.3
10	..	— 0.3

The results presented above indicate that the contribution of a panicle to

yield declines with the lateness of its development. The regression coefficients are -0.4 for plants with 5-8 tillers and -0.3 for plants with 9-10 tillers.

The plants belonging to the 10-tiller class were analysed further by dissecting the tillering zone, for determining the loci and the system of tillering. The mean weights of panicles in the sequence of the flowering and the tillering order are given in Table 4. In column 5 of this Table is given, as a percentage of the total weight, the contribution made both by the main and the 1st-order tillers and the 2nd-order tillers. As a supplement to these results similar figures corresponding to a first generation hybrid and a variety, "Djalen" in which 11 individuals were used, are given in columns 6 and 7.

TABLE 4—Mean Weights of Panicles in the Sequence of Flowering and Tillering order

Flowering order (1)	Tillering order (2)	Mean Wt. gm. (3)	Percent. of total Wt. (4)	10—Tiller Class		
				Percentage contribution		
				F 1 (5)	Djalen (6)	(7)
Main panicle	.. Main culm	4.4	.. 14.2	84.5	68.6	78.3
2nd	.. 1st-order	3.7	.. 11.9			
3rd	.. "	4.2	.. 13.5			
4th	.. "	4.1	.. 13.3			
5th	.. "	3.9	.. 12.6			
6th	.. "	3.1	.. 10.0			
7th	.. "	2.8	.. 9.0			
8th	.. 2nd-order	1.7	.. 5.5	15.5	25.5	21.7
9th	.. "	1.6	.. 5.2			
10th	.. "	1.5	.. 4.8			
	3rd-order	—	.. —	—	5.9	—

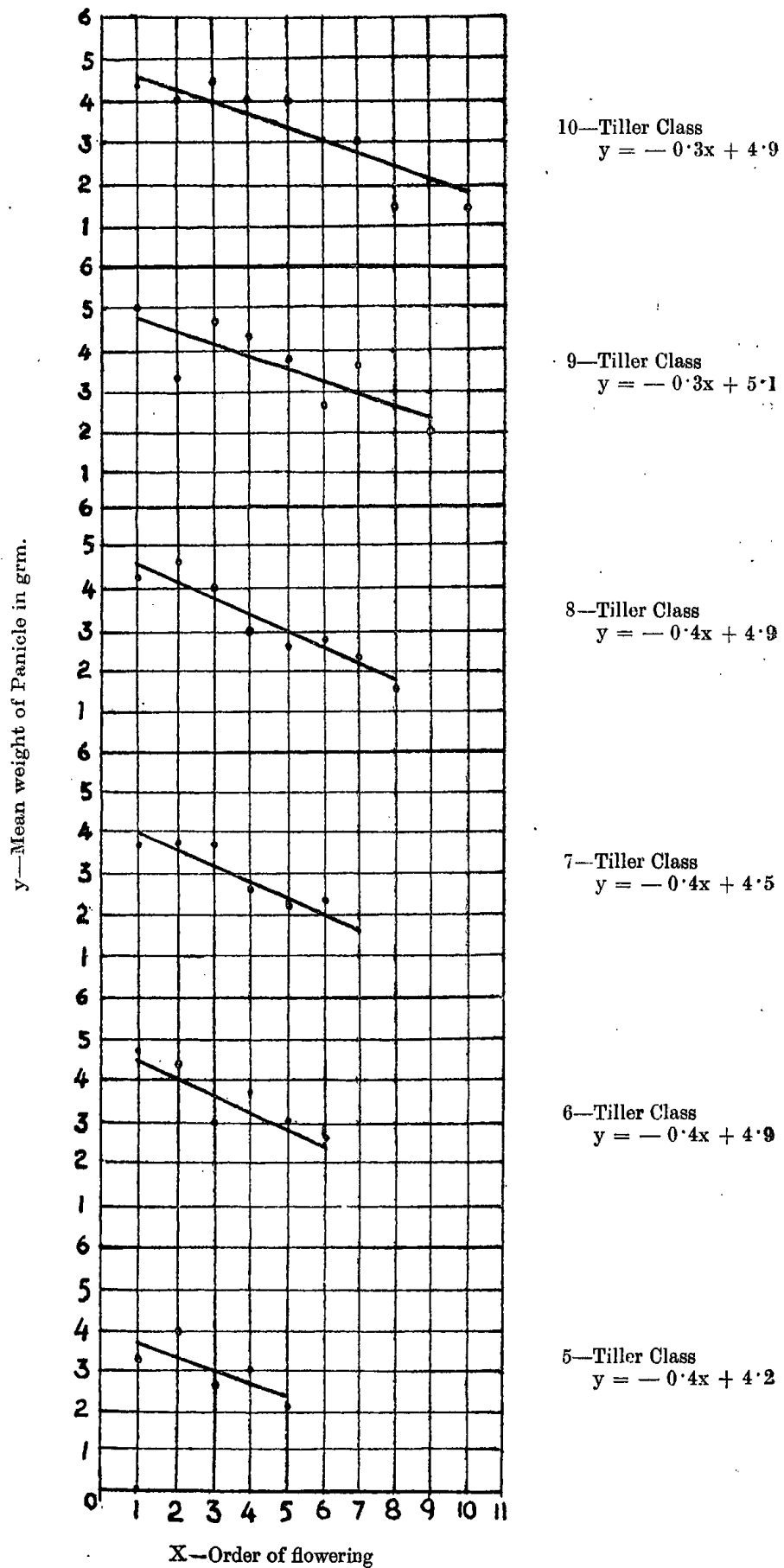


Fig. I—Regression Graphs of the different Tiller Classes

These figures show that it is the main culm and the 1st-order tillers that contribute mostly towards grain yield. The sudden drop in the panicle weight of the 2nd-order tillers is striking.

### Discussion

In the investigations reported herein, the contributions made to yield by sequence of tillers on a rice plant have been assessed: The main culm and the 1st-order tillers account for 69 to 85 per cent. of the yield of a plant. Cultural practices that promote the development of 2nd-order tillers would not conspicuously raise yields. It should be the breeder's objective to select strains in which the bulk of the tillers are of the 1st-order, and agronomic practices should aim at the elimination of higher-order tillers. The value of close planting in instances of certain varieties and conditions is evident.

### Acknowledgment

I am grateful to Dr. M. F. Chandraratna for his valuable criticism of this paper.

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