PHOTOPERIODIC STUDIES ON RICE

V. The Index of Daylength Sensitiveness of Certain Varieties of Rice.

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(Received Feb. 20, 1969)

Introduction

It has been known from the studies of various investigators including the present authors that based on the response to daylength, rice can be divided into two groups, daylength sensitive and daylength nonsenitive. Investigators in the past usually compared the heading dates of daylength sensitive vrieties grown under short day and natural conditions and derived the accelerated rates of heading of these varieties (Fuke 1931, Suenaga 1936). However, the daylength under natural conditions is in a state of gradual change, and when it is used as control for the same variety in the same season, the accelerated rate of heading so obtained may represent the degree of heading promotion of a variety under short day conditions. These rates do not indicate the definite daylength sensitiveness of a certain variety, nor do they reveal the differences among various varieties as to their daylength sensitiveness.

The purpose of the present study is to find a stable value which definity represents the daylength sensitiveness of a variety and which can be used for comparison among different varieties regarding their daylength sensitiveness.

Materials and Methods

(1) *Varieties*

185 varieties were used in this study. A description of these varieties is presented as follows:

Variety classification and origin.	No. of varieties	Catalogue No.	Remarks
Taiwan Ponlai varieties (Taiwan developed Japonica type varieties)	26	1-26	Preserved varieties of Taiwan Agricultural Research Institute
Japanese varieties	28	27-54	Introduced by C. J. Yü in 1956
Taiwan Native varieties (Indica type varieties)	25	55-79	Preserved varieties of Taiwan Agricultural Research Institute
Mainland varieties	42	80-121	Preserved varieties of Taiwan Agricultural Research Institute
American and Southeast Asian varieties	15	122-136	Preserved varieties of Taiwan Agricultural Research Institute
Genetic markers	49	137-185	Introduced from Jodon and Nagao

(2) *Experimental dates, sites and local daylength and temperature.*

The present study was conducted in 1957 in Taiwan Agrictultural Research Institute at Taipei (25°02′N latitude and 121°31′ longitude), where the longest day is June 22 (daylength 13 hr 42 m) and the shortest day is December 22 (daylength 10 hr 35 m).

In Taiwan, particularly in the north, two crops of rice are usually grown between January and July and between July and December, respectively. During the first crop, the daylength gradually increases from 11 hours in January to about 13 hours 30 minutes in mid-July. During the second crop, the daylenthg gradually decreases from 13 hours 30 minutes to about 11 hours in mid-November. Temperature changes from low to high during the first crop and from high to low during the second crop. Thus, the mean daily temperature in the vegetative growth and head forming stage (from April to June) is generally lower during the first crop than during the second crop, while the mean daily temperature in the period from head forming stage, through heading stage up to ripening stage is higher during the first crop than during the second crop. Because of these temperature patterns, the duration required to attain ripeness to flower is longer in the first crop than in the second, while the duration between floral differentiation and heading is slightly shorter in the first crop than in the second. Such a phenomenon is specially marked in those varieties which have relatively longer basic growth periods and are daylength insensitive.

(3) *Treatments*

There were three treatments: (a) Short day, nine hours of daylight from 8 a.m. to 5 p.m. and the rest of the day in the dark room; (b) long day, nine hours of daylight and the rest of the day exposed to light from 200 watt tungsten lamps, making a total of 24 hours of light, and the average intensity of the lamp light which the rice plant received was 40 foot candle; (c) Natural conditions.

(4) *Culturing, management and recording.*

Seeds were germinated by soaking before planting. The seeding dates of the fiirst and second crops were February 19 and July 28, respectively. Seedlings were transplanted after the emergence of the fifth leaves. The transplanting dates of the first and second crops were April 3 and August 14, respectively. The area of pot was 1/200,000 ha. Three seedlings of a variety were transplanted in one pot. All seedlings were grown under 24 hours photoperiod, and as soon as growth vigor was restored, experimental treatments were started. The starting date of treatments was April 20 for the first crop and August 19 for the second crop.

All management practices were in accordance with the experimental routine for rice in Taiwan.

The heading date of each plant was recorded.

Results

The heading dates (average of three plants) of different varieties undergoing various photoperiodic treatments were converted into the number of days between the beginning of treatment and the onset of heading. The detailed records are listed in Appendix, while some of the results are extracted as shown in the following table.

Table 1. *The days required from the beginning of treatment to the beginning of heading under different daylengths and index of daylength sensitiveness for different rice varieties.—an abstract from the appendix.*

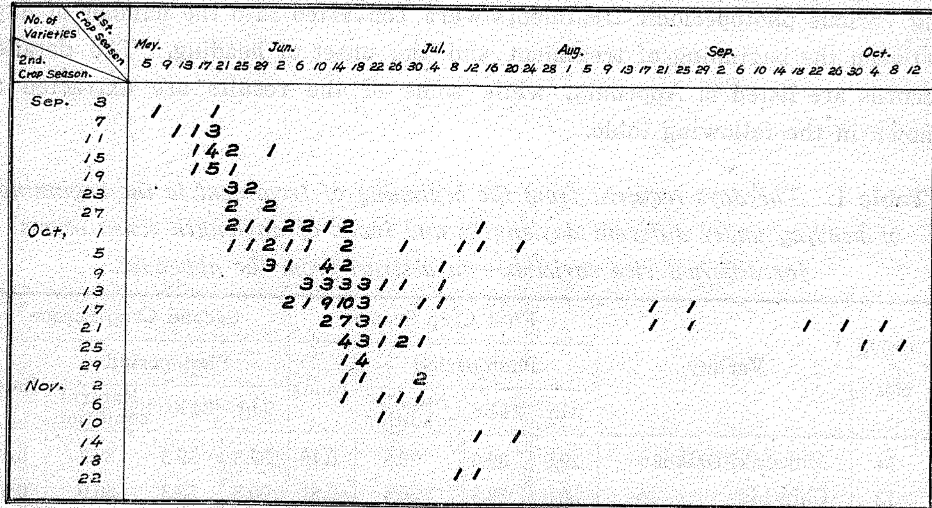
Catalog No.	Variety	First Crop Season				Second Crop Season			
		Photoperiod			Index	Photoperiod			Index
		9 hr	24 hr	Natural condition		9 hr	24 hr	Natural condition	
54	Murasaki-Daikoku	29.6	32.0	32.8	0.48	37.3	39.3	32.7	0.49
73	Chin-Liu	56.0	53.6	56.4	0.51	60.3	58.3	55.0	0.51
60	Chiai-Kotzu	58.0	60.0	61.0	0.49	65.6	71.0	67.1	0.48
33	Fukoku	24.0	40.3	23.3	0.37	31.3	59.6	22.3	0.34
85	Sinchiang-Tsaotao	28.0	43.0	30.1	0.39	16.3	55.0	22.6	0.23
35	Eiko	26.6	47.6	31.5	0.36	28.6	64.6	26.6	0.31
38	Rikuu No. 20	24.0	73.3	35.3	0.25	33.0	151.5	35.5	0.18
97	Li-Ku-Tsao	33.0	77.0	—	0.30	35.0	77.6	51.8	0.31
76	Ya-Mu	42.3	117.6	121.3	0.26	32.0	*	64.0	*
68	Shui-Chin-Chung	29.0	138.0	162.9	0.17	25.0	*	60.7	*
136	Macan-Bonet	42.3	*	—	*	51.6	*	86.7	*

— no record * no heading

1. *A comparison of the number of days from seeding to heading between the first and second crops grown under natural conditions.*

In 1957, a considerable number of varieties grown under natural conditions had similar number of days from seeding to heading during both the first and second crops (Examples are varieties 54, 73, 60 and 38 as shown in the above table). Some varieties had slightly longer periods from seeding to heading during the first crop than during the second crop (Examples are varieties 33, 35, 85, etc.) A few varieties showed great differences in this respect between the first and second crops. These latter varieties did not head until after August in the first crop, yet required much shorter periods to start heading during the second crop (Examples are varieties 76 and 68). For detailed results please refer to Appendix. The distribution of heading dates of experimental varieties grown under natural conditions during the first and second crops is shown in Figure 1.

Fig. 1. The distribution of heading dates of experimental varieties grown under natural conditions during the first and second crops in 1957.



Seeding First crop Feb. 19, 1957. Second crop July 28, 1957. Transplanting Apr. 3, 1957. Aug. 14, 1957.

It is suggested that the varieties plotted on the right side of Figure 1 are daylength sensitive ones. It is difficult to ascertain whether the varieties plotted on the left side of Figure 1 can all be considered as daylength insensitive ones.

2. *The variation of the number of days from seeding to heading of different varieties under 9-hour and 24-hour light periods.*

When different varieties were exposed to 9-hour light period during the first and second crops, there was some variation in the number of days from seeding to heading between the two crops. However, a positive correlation between crops always existed ($r=0.859^{**}$)

Under 24-hour light period during the first crop, most varieties had already headed before July 24 while 25 varieties did not head until after July 26. During the second crop, most varieties completed their heading before November 30, While a part of the varieties were late in heading or failed to head. The latter varieties had longer basic growth periods, and when they encounted lower temperatures during the later stage of growth, they became even slower in heading. The distribution of the heading dates of experimental varieties grown under 24-hour light period during the two crops is shown in

Figure 3. By eliminating the varieties which headed later than in November or failed to head due to temperature effects, the correlation between the first and second crops of the heading dates of various varieties under 24-hour light period was found highly significant (r=0.925**).

Fig. 2. The distribution of the heading dates of rice varieties grown under 9-hour light period during the first and second crops.

No. of Varieties / 2nd Crop Season \ 1st Crop Season	May. 5	9	13	17	21	25	29	Jun. 2	6	10	14	18	22	26	30	Jul. 4	8	12	16	20
Sep. 3		1	1	1																
7	1	1	1	2																
11		2	2	5	2															
15		1	1	8	2	1	2													
19		1	1	7	5	3														
23				5	5	4	1		1											
27				2	2	1	1		1		1									
Oct. 1					1	3	2	1												
5				1	1	1	1	1			1									
9				1			3	2	1	1	3	2	1							
13			1	1	1		1		1	5	1		1							
17								1		2	4									
21										5	3	7	1							
25									1	1	3	6								
29						1				2	2	4		1	1					
Nov. 2												6	3	2						
6												1		2						
10																				
14																				
18													1							
22													1							
26																				
30																				
Dec. 4																				
8																				
12														1						
16																				

$r=0.859^{**}$

In Figure 4 is shown the correlation between the 9-hour and 24-hour light periods of the heading dates of varieties grown in the first crop. The number of days from seeding to heading of a part of the varieties did not seem to be affected at all by the length of light periods. However, there were 39 varieties which had a relatively short duration between seeding and heading under 9-hour light period and a significantly prolonged one under 24-hour light period. By comparing Fig. 4 with Fig. 1, we can see that the distribution of heading dates of different varieties is rather similar. Thus we may consider those with short growth period under 9-hour photoperiod and long growth period under 24-hour photoperiod as highly daylength sensitive varieties, which were marked with circle in Figure 4.

Fig. 3. The distribution of heading dates of rice varieties grown under 24-hour light period during the first and second crops in 1957.

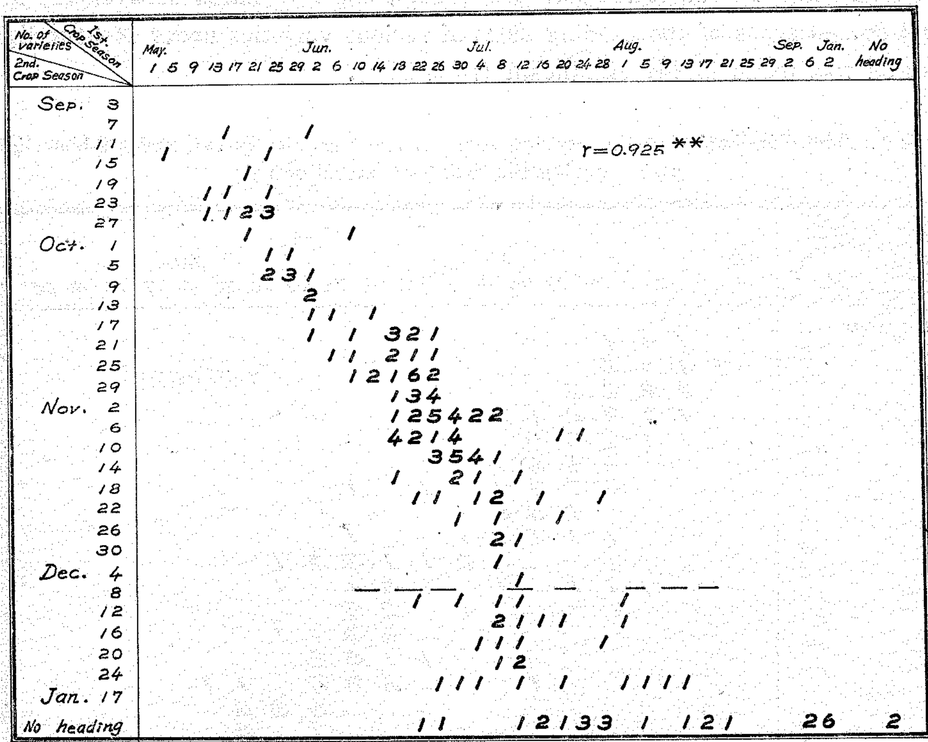
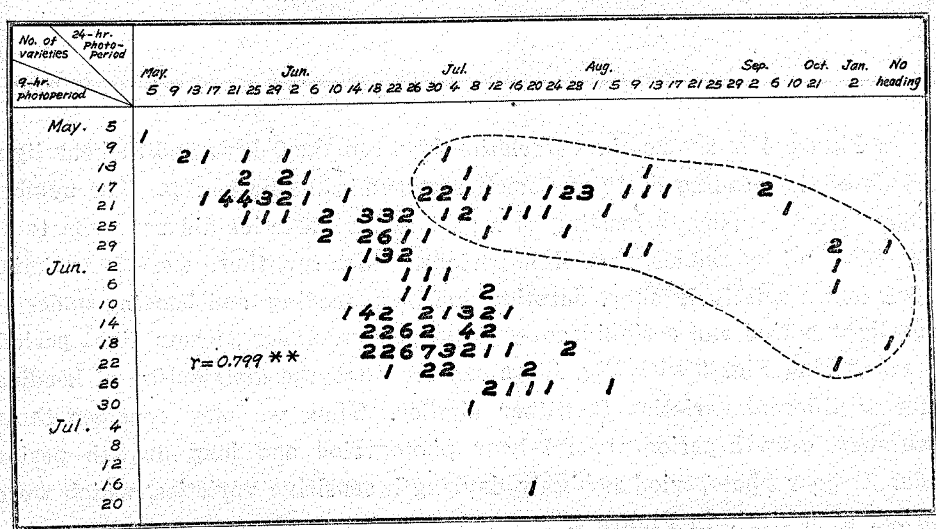
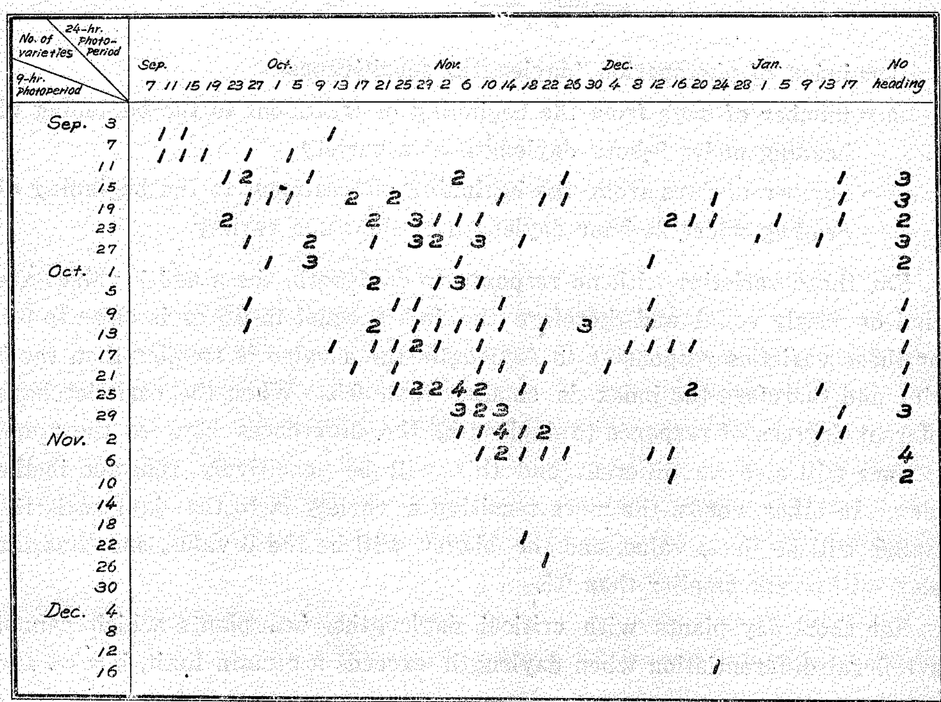


Fig. 4. The distribution of heading dates of rice varieties grown under 9-hour and 24-hour light periods in the first crop in 1957.



The distribution of heading dates of different varieties grown under 9-hour and 24-hour light periods in the second crop is shown in Figure 5. The experimental varieties and methods are the same in the first crop. Probably because of the difference in the temperature during the two crops, the distribution of headihg dates in Figure 5 is rather haphazard, making it impossible to differentiate the highly daylength sensitive varieties.

Fig. 5. The distribution of heading dates of rice varieties grown under 9-hour and 24-hour light periods during the second crop in 1957.



Discussion

1. *Index of daylength sensitiveness.*

In the section on experimental results and the appendix, we have listed the number of days from the initiation of treatment to the onset of heading of experimental varieties grown under 9-hour and 24-hour light periods and natural conditions during the two crops. We have also calculated the correlation coefficient between crops and among light treatments. An indicator capable of showing the degree of response of different varieties to daylength is yet to be derived.

By a careful study of the experimental data, we can see that under 9-hour (short day) and 24-hour (long day) light periods, some varieties had equal or almost equal number of days from the beginnining of treatmont to the onset of heading while some varieties showed considerable differences among them, the degree of difference varying with varieties. Since unlike the daylength under natural conditions, the 9-hour and 24-hour daylengths are fixed, we believe an index respecting the degree of response of different varieties to daylength may be derived from the number of days between the beginning of treatment and the beginning of heading of varieties under 9-hour and 24-hour daylengths. The index we suggest is as follows (Cf. Hara, 1930):

$$I = \frac{a}{a+b}$$

I = index of photoperiod (daylength) sensitiveness

a = number of days from the beginning of treatment to the beginning of heading under 9-hour daylength of a variety

b = number of days from the beginning of treatment to the beginning of heading under 24-hour daylength of the same variety

For those varieties with no response to daylength, the a and b values are equal or nearly equal, and therefore the index equal to 0.5 or is close to 0.5. For these varieties responsive to daylength, the a value is smaller than the b value and therefore the index is smaller than 0.5. When the varieties have different degrees of response to daylength, the differences between the a and b values will also be different and this will be sensitively reflected in the index. In other words, the more sensitive a variety is to the daylength, the smaller will be the a value, and the bigger will be the b value, and thus the index will be far smaller than 0.5.

For short day plants with critical daylengths, i.e., plants which cannot have floral differentiation when daylength exceeds a certain limit, $b = \infty$, and

$$\lim_{b \to \infty} \frac{a}{a+b} = 0$$

Therefore, the index of daylength sensitiveness of short day plants is between 0.5 and 0. The nearer to 0 the index is, the more daylength sensitive the variety is.

We think the same formula can apply to long day plants. In long day plants $a > b$. For those long day plants with critical daylength, i. e., those which cannot have floral diffentiation when daylength is shorter than a certain limit, $a = \infty$, and

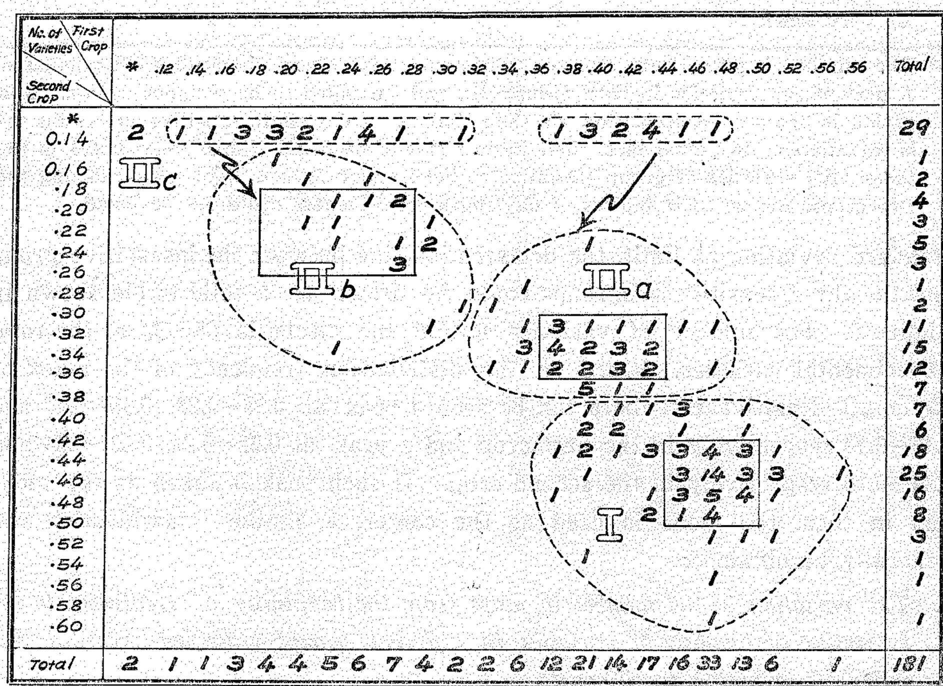
$$\lim_{a \to \infty} \frac{a}{a+b} = 1$$

Thus the index of long day plants is between 0.5 and 1. The nearer to 1 the index is, the more daylength sensitive the variety is.

2. *The applications of the index of daylength sensitiveness.*

The indices of day-length sensitiveness were calculated from the experimental data in this study as shown in Table 1 and in Appendix. A careful study reveals that the indices of a number of varieties have a continuous distribution. The correlation between the two crops of the indices of various varieties is shown in Figure 6.

Fig. 6. The correlation between the two crops of the indices of daylength sensitiveness of various varieties.



* The asterisk indicates that the following varieties, all of which were grown under a 24 hour photoperiod did not head before the end of this investigation, and so no index is given for them.

From the varietal distribution on the basis of the index and the position of mode in the distribution as shown in Figure 6, we may divide our experimental varieties into two groups, daylength sensitive and daylength insensitive. Based on the differences in response between the two crops, the daylength sensitive group can further be subdivided into three subgroups, daylength slightly sensitive, daylength sensitive and daylength very sensitive. These subgroups are marked with symbols in Figure 6. From Figure 6, the indices of different groups in the two crops and the number of varieties belonging to different groups are calculated as shown in Table 2.

With the mean index of daylength sensitiveness in Table 2 as center and

Table 2. *The distribution of the index of daylength sensitiveness of varieties of daylength sensitive and daylength insensitive groups in the two crops.*

	First crop		Second crop	
	No. of varieties	Index M± S	No. of varieties	Index M± S
I Nonsensitive group	86	0.473±0.036	86	0.457±0.033
II Sensitive group				
a) Slightly sensitive	55	0.402±0.034	47(9)	<0.337±0.028
b) Sensitive	37	0.241±0.042	20(16)	<0.230±0.046
c) Very sensitive	2	*	2	*

* The number in parentheses represent varieties the indices of which were not calculated. A part of the varieties in both groups IIa and IIb failed to head under 24-hour light period in the second crop, and so their indices of daylength sensitiveness could not be calculated. In actual fact, their indices should be smaller than those listed in the table. All varieties of group IIc failed to head under 24-hour light period during the two crops, and so their indices of daylength sensitiveness could not be listed.

standard deviation as limit, the demarcation line between the insensitive group and the three sensitive subgroups could be drawn as a solid circle shown in Figure 6. The number of varieties within the circle is 68.27% of the total experimental varieties. Based on the distribution frequency of the index of daylength sensitiveness, there can be seen a peak at 0.26—0.28, 0.38—0.40 and 0.46—0.48 respectively in the first crop and a peak at 0.22—0.24, 0.32—0.34 and 0.44—0.46 respectively in the second crop. If such peak is taken as the mode and in turn, the mode is used as the center, a similar classification can generally be obtained.

3. *The variation in the number of days from the beginning of treatment to the beginning of heading of varieties in different groups classified according the index of daylength sensitiveness.*

In Table 3 is shown the variation in the number of days from the beginning of treatment to the beginning of heading of varieties in the daylength

Table 3. *The variation in the number of days from the beginning of treatment to the beginning of heading of varieties in the daylength insensitive group and the three daylength sensitive groups grown under different photoperiods.*

Group	First crop			Second crop		
	9-hour photoperiod	24-hour photoperiod	Natural condition	9-hour photoperiod	24-hour photoperiod	Natural condition
I	49.79±15.38	57.68±19.41	52.68±14.36	58.67±19.07	69.97±22.84	52.78±14.87
IIa	47.46±14.60	71.37±14.63	61.12±16.55	49.30±17.15	> 88.37±28.85	55.72±17.91
IIb	34.00± 7.87	114.44±49.76	84.30±44.86	36.00±10.86	>114.74±25.82	51.54±13.21
IIc	52.95±15.06	*	—	59.95±11.81	*	85.65± 1.49

insensitive group and the three daylength sensitive groups grown under different photoperiods during the two crops.

From Table 3, it is possible to compare the number of days from the beginning of treatment to the onset of heading of different groups of varieties grown under different photoperiods. For varieties of group I (daylength insensitive group), these should not have been variation among different photoperiods. In Appendix, we may also be able to find such varieties as having no variation among different photoperiods. However, since we were not able to control all possible effects caused by the prolonged photoperiod and also since classification of groups may not have been adeqate where groups I and IIa varieties were in nearly continuous distribution, the mean duration from the beginning of treatment to the beginning of heading of our group I was about 10 days longer under 24-hour photoperiod than under 9-hour photoperiod during both crops.

In group II (daylength sensitive group), the effects of daylength on heading were very marked. Besides, such effects varied with crop seasons. During the first crop, the mean difference in the period from the beginning of treatment to the beginning of heading between 9-hour and 24-hour photoperiod was 24 days in group IIa, 79 days in group IIb, and at least more than 235 days in group IIc. The group IIc varieties under 24-hour photoperiods did not head even by January 31 of the following year. During the second crop, the same mean difference was over 36 days in group IIa, over 79 days in group IIb, and over 107 days in group IIc.

During both crops, the duration of growth period under natural conditions was slightly shorter than under 9-hour and 24-hour daylengths in group I varieties and was between 9-hour and 24-hour daylengths in group II varieties.

4. *The correlation of the number of days from treatment to heading of different groups of varieties under 9–hour and 24–hour daylength.*

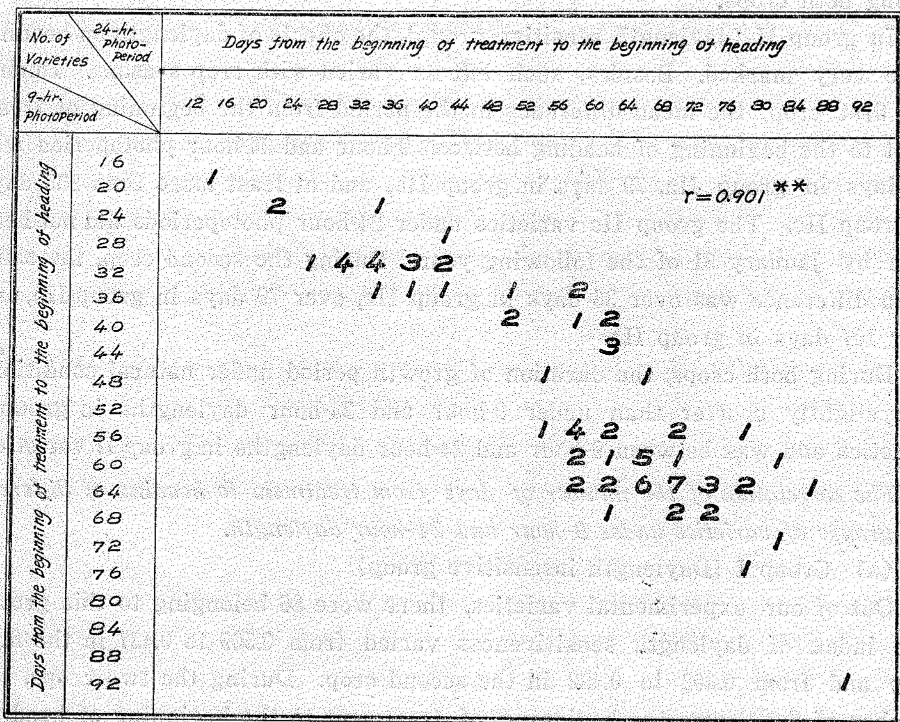
(a) Group I (Daylength insensitive group)

Out of our experimental varieties, there were 86 belonging to this group. The index of daylength sensitiveness varied from 0.509 to 0.437 in the first crop and from 0.492 to 0.422 in the second crop. During the two crops, the number of days from the beginning of treatment to the beginning of heading of each variety under 9-hour daylength was very close, with a correlation coefficient of $r=0.859^{**}$ (see Figure 2). These figures may be considered as the basic number of days of growth of the respective varieties. The majority of Group I varieties had a slightly longer duration between treatment and heading under 24-hour daylength. In the first crop, the mean increase in duration was 7.89 days. The greatest increase in duration, however, did not result in more than 0.27 times of the basic number of days of growth (see

Table 3). In the second crop, owing to the lowering temperature, the difference in the number of days from the beginning of treatment to the beginning of heading between the 9-hour and 24-hour photoperiods became longer, with a mean of 11.29 days. The biggest difference still did not result in more than 0.38 times of the basic number of days of growth. Again, during both crops, the growth periods of all varieties under 24-hour daylength were generally uniform in duration (see Figure 2).

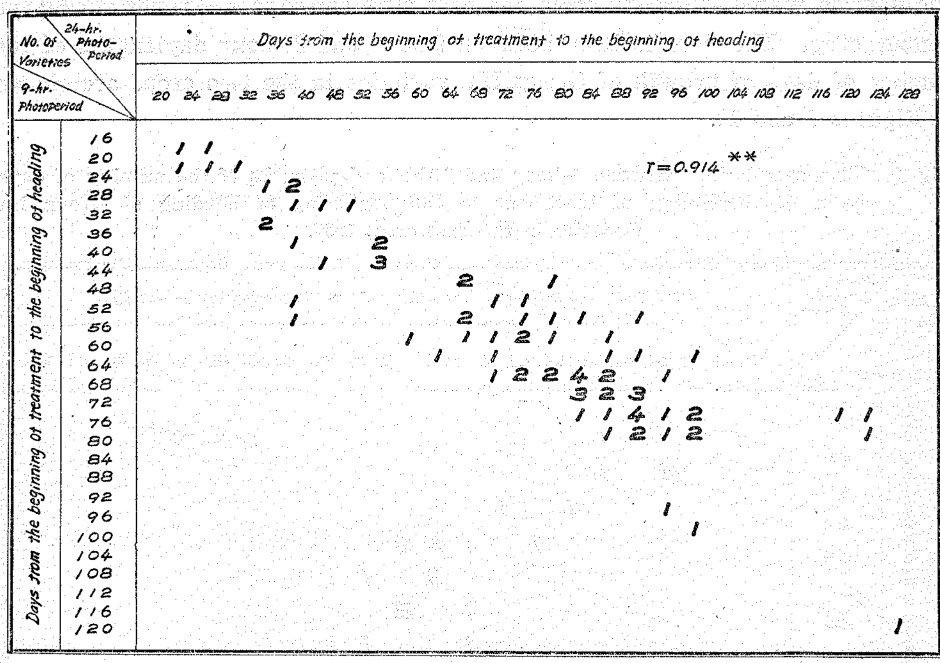
By arranging the number of days from treatment to heading of this group of varieties under 9-hour and 24-hour daylengths in the same crop, the results are shown in Figures 7 and 8.

Fig. 7. The correlation between 9-hour and 24-hour daylength of the number of days from the beginning of treatment to the beginning of heading of Group I varieties in the first crop, 1957.



From Figures 7 and 8, it can be seen that Group I varieties had no response or nearly no response to daylength. The differences in the number of days from treatment to heading among varieties were mainly due to genes controlling heading date (Yao and Yü, 1963). That the varieties generally tended to have slightly longer growth periods in the second crop was probably caused by low temperature.

Fig. 8. The correlation between 9-hour and 24-hour daylengths of the number of days from the beginning of treatment to the beginning of heading of Group I varieties in the second crop, 1957.



(b) Group IIa (Slightly sensisitve group)

Out of our experimental varieties, there were 56 belonging to this group. During the first crop, all varieties were able to head under 24-hour photoperiod, yet the mean heading dates was 23.91 days later under 24-hour photoperiod than under 9-hour photoperiod. During the second crop, the varieties with shorter basic growth period already headed before temperature became too low for heading. The differences in the duration of the growth period of these varieties between 9-hour and 24-hour photoperiods were relatively small (larger than in Group I). However, the varieties with longer basic growth periods, having been prolonged in their growth under 24-hour photoperiod, encounted the lowering temperature, and thus headed even later or failed to head at all. As a result, the difference in the duration of growth period between 9-hour and 24-hour photoperiods became as great as more than 88.27 days. Upon examing the growing points of those varieties which had not headed on the 120th day after the beginning of treatment (December 16), we found the floral buds had all differentiated in varying degrees. On the 150th day after treatment, there were still 9 varieties which had not headed. It the varieties which failed to head because of longer basic growth periods and the encounter of low temperature were eliminated, then the duration of growth period of the Group

IIa varieties was longer under the 24-hour photoperiod than under the 9-hour photoperiod to a certain limit. That is, the increase in duration under 24-hour photoperiod was 0.78 times during the first crop and was 1.33 times during the second crop. The correlatioon between 9-hour and 24-hour daylengths of the number of days of growth of Group IIa varieties in the two crops are shown in Figures 9 and 10.

Fig. 9. The correlation between 9-hour and 24-hour daylengths of the number of days from the beginning of treatment to the beginning of heading of Group IIa varieties in the first crop, 1957.

No. of Varieties; 24-hr. Photo-period (columns); 9-hr. Photoperiod (rows)	Days from the beginning of treatment to the beginning of heading																					
Days from the beginning of treatment to the beginning of heading	24	28	32	36	40	44	48	52	56	60	64	68	72	76	80	84	88	92	96	100	104	108
20	1				1																	
24			2		1	1																
28						1		1														
32							1		1	4	2											
36										3	1	1										
40									1		2											
44									1			1	1									
48											1	1			2							
52													1	2	2	1						
56										1	1	1		4	1							
60															1			1	1			
64																	2					
68															1	1	1	1			1	
72																						

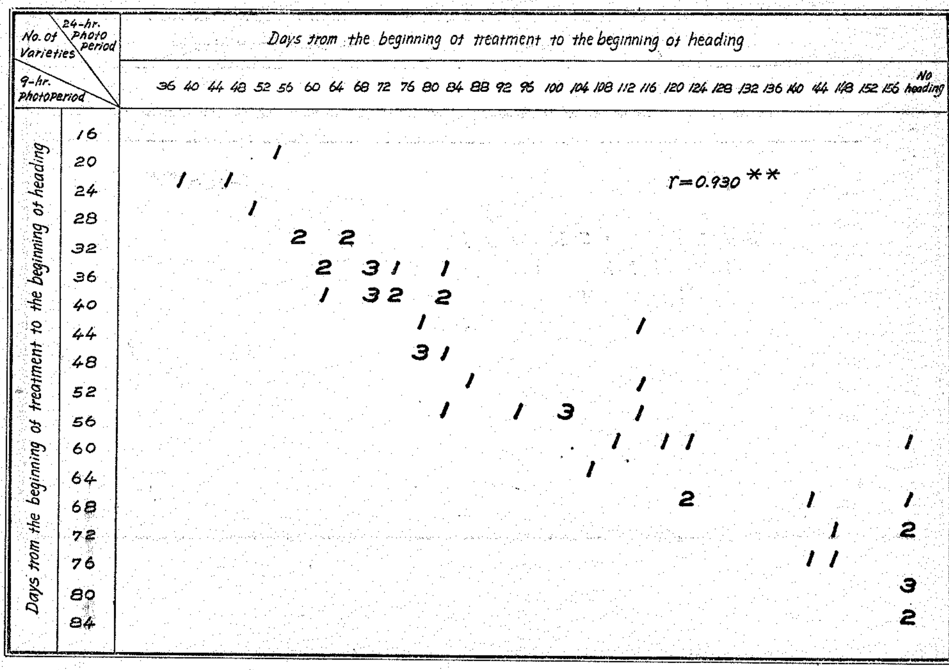
r=0.885 **

The characteristic of this group of varieties is the substantially smaller index of daylength sensitiveness in the second crop than in the first crop. However, a careful study of Figures 9 and 10 would indicate that the smaller index in the second crop was mainly caused by the varieties with longer basic growth periods which previously had a slow down in growth under 24-hour photoperiod and further delayed their growth upon the encounter of low temperature. In other words, during the second crop, the b value in the formula of the index of daylength sensitiveness was affected not only by the 24-hour photoperiod but also by the temperature factor. As b value increased, the index became smaller.

(c) Group IIb (Sensitive group)

Out of our experimental varieties, there were 37 belonging to this group. During the first crop, the index of daylength sensitiveness was 0.241±0.042.

Fig. 10. The correlation between 9-hour and 24-hour daylengths of the number of days from the beginning of treatment to the beginning of heading of Group IIa varieties in the second crop, 1957.



The number of days of growth under 24-hour photoperiod was 1.33 to 3.00 times greater than under 9-hour photoperiod. It was 6.33 times greater in a part of varieties. During the second crop, since about half of the varieties failed to head under 24-hour photoperiods, the actual index of daylength sensitiveness was smaller than 0.23±0.046 as listed in Table 2. The correlations between 9-hour and 24-hour daylengths of the number of days from the beginning of treatment to the beginning of heading of Group IIb varieties in the two crops are shown in Figures 11 and 12.

From Figure 11, the correlation coefficient of the duration of growth period between 9-hour and 24-hour daylengths in the first crop was calculated as 0.722 **. In other words, in the first crop, the durations of growth under 24-hour daylength, although prolonged, still maintained rather marked proportion to that under 9-hour daylength. In the second crop, however, owing to the high daylength sensitiveness coupled with low temperature effects, these appeared almost no correlation of the number of days of growth between 9-hour and 24-hour daylengths.

(d) Group IIc (Very sensitive group)

Out of our experimental varieties, there were only two varieties belonging to this group. Both headed only under 9-hour daylength in two crops, while

Fig. 11. The correlation between 9-hour and 24-hour daylengths of the number of days from the beginning of treatment to the beginning of heading of Group IIb varieties in the first crop, 1957.

Days from the beginning of treatment to the beginning of heading

No. of Varieties; 24-hr. Photo-Period / 9-hr. Photoperiod (Days from the beginning of treatment to the beginning of heading)	68	72	76	80	84	88	92	96	100	104	108	112	116	120	124	128	132	136	140	144 ……	184	188 ……	224	228	232	236 ……	256	260
20																												
24		1																										
28			1									1																
32	2	2	1	1			1	2	3		1	1	1					2										
36		1	2		1	1	1			1									1									
40				1				1																				
44													1	1														
48																					1				1		1	
52																							1					
56																												
60																												
64																												
68																								1				

r=0.722**

Fig. 12. The correlation between 9-hour and 24-hour daylengths of the numer of days from the beginning of treatment to the beginning of heading of Group IIb varieties in the second crop, 1957.

Days from the beginning of treatment to the begnning of heading

No. of Varieties; 24-hr. Photo-Period / 9-hr. Photoperiod (Days from the beginning of treatment to the beginning of heading)	76	80	84	88	92	96	100	104	108	112	116	120	124	128	132	136	140	144	148	152	No heading
24																					
28	2					1													1		3
32			1		1	1							1			1			1		3
36	1										2	1	1			1			1		2
40				1											1			1			3
44																					2
48																					
52																					
56																					1
60										1											
64																					1
68																					
72																					
76																					
80																					
																					1

r=0.201

both failed to head under 24-hour daylength in two crops. In Group IIb, a part of varieties did not head under 24-hour daylength in the second crop, yet all headed under 24-hour daylength in the first crop, although their growth periods were quite prolonged. On the other hand, all plants of Group IIc varieties including the first and second crops grown under 24-hour daylength died out in February of 1958 under natural conditions. Therefore, the index of daylength sensitiveness of these varieties in two crops is 0 or very nearly 0.

5. *Comments on the factors affecting the growth period of rice.*

From what have been described above, we can see that the durations of the period from the beginning of treatment to the beginning of heading under short day and long day conditions were equal or near equal in a part of varieties, and were unequal in still another part of varieties, their degree of unequality varying with individual varieties. Under long day conditions during the second crop, a part of varieties were also obviously adversely affected by low temperature.

We have proviously suggested that in daylength insensitive varieties, heading date is entirely controlled by "heading date genes" (Ausschusszeitengen) and the hybrid between early maturing varieties and late maturing varieties clearly demonstrated the behaviour of quantitative inheritance (Yao and Yü, 1963). We have also pointed out that at optinum temperature, the daylength insensitive varieties would demonstrate the shortest growth period, which we considered as the basic vegetative growth period. This basic period would vary among the different daylength insensitive varieties (Yü and Yao, unpublished). Such varietal differences should have been caused by the varying numbers or combinations of heading date genes. However, at low temperature the vegetative growth period of these varieties generally became proportionately prolonged. Therefore, the growth period of daylength insensitive varieties must be controlled by two factors, (a) "heading date genes" controlling the basic vegetative growth period, (b) temperature.

Among our experimental varieties, a few headed within 30 days under 9-hour daylength. An extreme example is Norin No. 11 which headed 16.3 days after treatment under 9-hour daylength and 13.3 days after treatment under 24-hour daylength. This means its floral initiation must have taken place long before the beginning of treatment. However, all plants were under 24-hour daylength before treatments were started. There can be no doubt that this is a daylength insensitive variety. Moreover, this is also a variety with a very short basic vegetative growth period.

For the daylength sensitive varieties, we have also pointed out that their growth period was controlled by "heading date genes" and "photoperiodic genes"

(Photoperiodizitätsgen, Yü u. Yao, 1957, 1968) and that the latter genes were epistatic to the former genes (Yü u. Yao 1957). It is known from the present study that temperature adversely affected photoperiodic response, and that the longer the basic vegetative growth period was, the more marked the temperature effects would be. Our present experimental results seem to demonstrate clearly the complex effects on the duration of vegetative growth period of daylength sensitive varieties by the following three factors, (a) basic number of days of vegetative growth as controlled by "heading date genes", (b) "photoperiodic genes", and (c) temperature. As to the varietal differences in the response to daylength reflected by the index of daylength sensitiveness, further studies are needed to determine whether these are due to qualitative or quantitative differences in photoperiodic genes.

In Japan, Asakuma (1958) also considered the basic vegetative growth habit, the sensitivity to daylength and the sensitivity to temperature of daylength sensitive varieties. However, their temperature and other environmental factors were different from those in Taiwan. Also, no 24-hour daylength treatment was included is his experiment. Therefore, it is not possible to make comparisons between his and our results.

Summary

(1) 185 rice varieties of different origins were treated under short daylength (9-hour) and long daylength (24-hour) during the first and second crops in 1957. The number of days from the beginning of treatment to the beginning of heading of each variety was recorded.

(2) An index of daylength sensitiveness was suggested and could be calculated from the following formula:

$$I = \frac{\text{Number of days of vegetative growth under short day (9 hr.)}}{\text{Number of days of vegetative growth under short day (9 hr.)} + \text{Number of days of vegetative growth under long day (24 hr.)}}.$$

This index was taken as a standard for juding the daylength sensitiveness of different varieties.

(3) Based on the index of daylength sensitiveness, 185 experimental varieties were divide into two groups, daylength insensitive and daylength sensitive. The latter group was further divided into three subgroups, slightly sensitive, sensitive and very sensitive.

(4) The factors controlling the growth period of daylength insensitive and daylength sensitive varieties were briefly discussed.

水稻光週性的研究

V. 若干水稻品種的光週性指數

于景讓 姚潤德

1. 作者等以來源不同的185個水稻品種，在1957年的第一季與第二季，分別置短日長（9小時）與長日長（24小時）下，記錄其自開始處理至開始抽穗的日數。

2. 作者等提出以 $\frac{\text{短日長(9小時)下生長日數}}{\text{短日長(9小時)下生長日數}+\text{長日長(24小時)下生長日數}}$ 的數值爲光週性指數，而以此指數爲判斷品種的光週感應性強弱的標準。

3. 作者等根據光週性指數將供實驗用的185品種劃分爲光週不感應與光週感應二大羣，又以後者劃分爲稍敏感、敏感、極敏感等三亞羣。

4. 作者等對於支配光週不感應、光週感應品種的生長期的要素，簡略地加以討論。

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Appendix

*The classification of rice varieties according to the indices of their photosensitiveness** (*Continued 1*)

Variety	First Crop Season				Second Crop Season			
	Photoperiod			Index of photo-sensi-tiveness	Photoperiod			Index of photo-sensi-tiveness
	9-hour	24-hour	Natural condition		9-hour	24-hour	Natural condition	
Group 1.								
34 Norin No. 11	16.3	13.3	18.0	0.56	20.6	25.0	16.4	0.45
44 Norin No. 15	22.6	22.6	26.5	0.50	26.3	34.3	24.1	0.43
138 A-13 (Chabo)	23.3	23.6	23.0	0.50	27.3	38.0	20.7	0.42
144 H-25	—	26.0	32.0	—	33.6	33.3	30.6	0.50
46 Norin No. 20	28.3	27.3	29.8	0.51	17.6	21.0	27.5	0.46
140 A-58	28.6	31.3	31.3	0.48	31.0	37.0	32.0	0.46
30 Wase-Nishiki	29.6	30.0	31.4	0.50	24.0	30.6	31.9	0.44
29 Ishikari-Shirage	29.6	32.0	32.1	0.48	32.0	42.6	36.8	0.43
54 Murasaki-Daikoku	29.6	32.0	32.8	0.48	37.3	39.3	32.7	0.49
139 A-32 (Furenbozu)	30.0	32.3	28.0	0.48	56.0	39.0	30.3	0.59
142 C-19 (Daikoku)	30.0	32.3	34.0	0.48	34.0	35.6	30.6	0.49
141 A-73	22.0	33.3	31.3	0.40	18.6	25.6	21.3	0.42
149 N-45 (Ezomotigata-Murasakiine)	29.0	34.0	34.0	0.46	28.0	40.0	24.2	0.41
143 H-9 (Ezokamairadzu)	30.6	34.0	37.3	0.47	49.3	38.0	35.8	0.56
83 Lu-shih-tsao	32.3	35.6	42.0	0.48	37.3	49.0	43.7	0.43
36 Hōkō	32.0	35.6	36.5	0.47	41.0	50.0	40.8	0.45
148 N-11 (Hokozima)	31.0	37.0	28.5	0.46	30.0	45.3	28.2	0.40
34 Shin'e	33.6	38.3	36.3	0.47	41.6	49.6	44.8	0.46
32 Tominishiki	31.3	39.3	34.5	0.44	40.3	51.3	40.5	0.44
147 N-1 (Akage)	32.0	40.3	31.5	0.44	20.6	21.6	24.1	0.49
31 Minamisakae	31.6	40.6	34.9	0.44	36.6	48.3	37.0	0.43
145 H-52	25.6	41.0	25.6	0.39	59.0	53.0	—	0.53
27 Tomoe'nishiki	33.0	44.0	34.9	0.43	47.3	61.3	43.0	0.44
80 Nan-te-hao	40.0	49.3	48.7	0.45	47.0	63.3	56.2	0.43
28 Tomoemasari	35.6	49.6	35.9	0.42	51.3	64.6	44.2	0.44
88 Sha-tiao-tao	38.0	49.6	54.0	0.43	40.6	42.3	41.1	0.49
50 Hokoku No. 1	45.3	53.6	50.3	0.46	53.0	70.6	59.6	0.43
73 Chin-liu	56.0	53.6	56.4	0.51	60.3	58.3	55.0	0.51
21 Nungshih No. 4	58.6	56.3	52.6	0.51	62.3	81.3	54.6	0.43
39 Rikuu No. 20	37.6	58.0	46.9	0.39	47.3	74.3	42.8	0.39
61 I-kung-pao	54.0	58.6	56.3	0.48	61.0	66.6	59.5	0.48
*86 Shenyang-hsien	36.0	59.0	42.0	0.38	—	—	—	—
87 Hei-tu No. 4	55.3	59.0	56.9	0.48	59.6	63.3	57.8	0.48
20 Chungnung-peng No. 389	56.0	59.0	55.4	0.49	67.6	88.6	53.7	0.43
103 Hsi-li-ku	60.3	59.0	64.7	0.51	54.6	63.3	56.3	0.46
105 Che-chang No. 5441	35.0	59.6	60.2	0.37	57.0	65.0	55.7	0.47
19 Kaohsiung No. 53	56.0	59.6	55.1	0.48	65.0	81.6	53.9	0.44
2 Nung-yü No. 2092	61.3	59.6	60.4	0.51	72.3	80.3	59.8	0.47

Appendix

(Continued 2)

Variety	First Crop Season				Second Crop Season			
	Photoperiod			Index of photo-sensitiveness	Photoperiod			Index of photo-sensitiveness
	9-hour	24-hour	Natural condition		9-hour	24-hour	Natural condition	
60 Chiai-ko-tzu	58.0	60.0	61.0	0.49	65.6	71.0	67.1	0.48
40 Kamenoo No. 4	43.3	60.3	46.9	0.42	56.0	79.3	48.7	0.41
42 Norin No. 1	44.0	61.6	46.6	0.42	56.3	84.0	49.5	0.40
41 Hatsunishiki	38.6	62.0	43.7	0.38	52.0	70.3	45.1	0.43
65 Taichung-pai-chueh	62.3	62.0	63.7	0.50	69.6	76.3	62.3	0.48
57 Ti-chiao-wu-chan	55.6	62.3	59.7	0.47	57.3	70.3	60.6	0.45
91 Chochou-tao	39.6	62.6	47.6	0.39	72.3	94.0	52.0	0.43
55 Taipei-wuchueh	55.3	63.0	61.6	0.47	66.3	72.0	67.6	0.48
99 Chung-chien No. 28	41.0	63.6	60.7	0.39	54.6	63.0	56.9	0.46
63 Taipei-Tuan-kuang-hualo	57.6	63.6	60.1	0.48	59.3	76.0	63.3	0.44
4 Taipei No. 127	61.6	63.6	61.4	0.49	68.0	80.6	56.0	0.46
92 Kuanyin-chan No. 16	67.0	64.0	—	0.51	58.0	69.0	58.7	0.46
56 Hualien-Liuchou	62.0	64.6	64.6	0.49	65.6	78.3	66.5	0.46
23 Taitung No. 16	61.0	65.0	53.9	0.48	69.6	85.3	58.5	0.45
*77 Chien-lo	—	65.0	—	—	68.3	76.3	67.9	0.47
3 Taipei No. 8	61.6	65.6	60.8	0.48	69.0	82.3	58.9	0.46
8 Taichung No. 150	57.0	66.0	59.9	0.46	63.6	85.0	55.8	0.43
161 No. 7134	56.6	66.6	57.2	0.46	60.3	92.7	57.9	0.39
1 Nung-yü No. 1805	57.3	66.6	58.9	0.46	75.0	79.6	57.6	0.49
6 Hsinchu No. 50	60.0	66.0	58.9	0.48	75.0	84.3	59.1	0.47
108 Chung-nung No. 4	61.3	66.6	63.7	0.48	67.0	67.3	59.0	0.50
112 Chung-hsiang No. 33-1	44.3	67.0	65.7	0.40	55.0	75.3	58.5	0.42
58 Taichung-wu-chien No. 2	64.0	67.0	65.4	0.49	67.0	76.0	70.8	0.47
81 Ya-erh-ho	60.0	67.3	60.6	0.47	65.0	77.0	47.2	0.46
64 Pai-mi-fen	64.0	67.6	65.2	0.49	67.6	74.0	68.6	0.48
66 Taipei-Hsia-chiao-liuchou	61.0	68.6	65.7	0.47	66.3	76.3	68.6	0.46
13 Chia-nung-yü No. 242	66.3	68.6	59.3	0.49	93.0	89.6	63.0	0.51
15 Chia-nung-yü No. 478	58.3	69.0	57.9	0.46	71.0	86.3	58.6	0.45
70 Ilan-chung	54.5	69.0	70.9	0.44	72.0	78.6	79.4	0.48
9 Kuang-fu No. 401	61.3	69.6	60.8	0.47	74.3	84.6	59.0	0.47
185 No. 9783	56.0	70.0	64.7	0.44	54.0	86.0	52.2	0.39
22 Nungshih No. 4	64.0	70.0	57.9	0.48	69.6	82.6	56.5	0.46
7 Taichung No. 65	62.0	71.0	58.7	0.47	77.6	80.3	59.6	0.49
62 Taitung-wu-chan	63.3	71.0	66.3	0.47	65.6	78.3	72.2	0.46
168 No. 7164	65.0	71.0	61.5	0.47	78.3	97.3	58.4	0.45
18 Kaohsiung No. 27	60.6	71.6	61.1	0.46	77.6	85.3	63.0	0.48
14 Chia-nung-yü No. 280	63.6	71.6	59.8	0.47	75.6	88.3	59.9	0.46
11 Chia-nan No. 8	63.0	72.3	61.3	0.47	73.6	85.3	61.2	0.46
17 Kaohsiung No. 22	66.6	73.0	62.6	0.48	77.6	89.6	68.2	0.46

Appendix

(*Continued 3*)

Variety	First Crop Season				Second Crop Season			
	Photoperiod			Index of photo-sensi-tiveness	Photoperiod			Index of photo-sensi-tiveness
	9-hour	24-hour	Natural condition		9-hour	24-hour	Natural condition	
25 Kaohsiung-yü No. 73	62.6	74.0	61.7	0.46	72.0	87.0	68.0	0.45
5 Hsin-nung-yü No. 17	62.6	75.0	61.4	0.45	78.3	84.6	59.7	0.48
12 Kuang-fu No. 1	66.3	75.6	62.1	0.47	97.0	94.3	64.9	0.51
10 Chia-nan No. 2	73.0	76.6	67.2	0.49	73.0	86.6	69.0	0.46
130 Ark Fortuna	62.6	77.5	76.4	0.45	77.0	113.3	67.7	0.40
24 Nan-kai-yü No. 2	64.0	79.3	61.8	0.45	77.0	95.0	60.4	0.45
157 No. 7114	54.0	80.0	76.5	0.40	74.3	93.0	73.0	0.44
176 No. 7243	71.0	82.3	79.5	0.46	120.0	128.0	77.0	0.48
165 No. 7156	60.0	83.0	—	0.42	—	—	—	—
152 No. 7101	61.0	85.0	62.0	0.42	82.3	118.6	73.3	0.41
123 Century Patna No. 52	89.3	91.7	78 0	0.49	78.3	117.7	72.1	0.40
Group IIa.								
48 Norin No. 34	23.0	25.0	31.7	0.48	20.3	38.0	29.1	0.35
137 A-5 (Akamura)	26.0	32.6	30.0	0.44	20.6	46.6	18.9	0.31
146 H-59	25.6	35.0	28.0	0.42	27.0	51.0	20.8	0.35
33 Fukoku	24.0	40.3	28.3	0.37	31.3	59.6	22.3	0.34
85 Sinchiang-Tsaotao	28.0	43.0	30.1	0.39	16.3	55.0	22.6	0.23
84 Ningshiao-Hsiaotao	30.0	47.0	31.7	0.39	30.3	59.3	26.6	0.34
35 Ekō	26.6	47.6	31.5	0.36	28.6	64.6	26.6	0.31
53 Daikoku	33.3	52.0	—	0.39	40.0	72.0	37.0	0.36
37 Bansei-Eko	31.0	53.0	34.9	0.40	33.6	71.3	26.2	0.32
45 Norin No. 17	37.0	57.0	45.9	0.39	47.0	79.6	46.7	0.37
89 Tzu-chin-ku	44.0	59.0	51.4	0.43	46.0	80.6	51.6	0.36
95 Chung-nung-yü-li-ysao	33.6	60.0	62.7	0.36	34.3	62.6	50.9	0.35
154 No. 7108	35.0	61.3	53.4	0.36	37.6	74.0	47.0	0.34
96 Chung-kuei-ma-fang-hsien	38.6	61.3	64.0	0.39	38.6	69.0	47.5	0.36
174 No. 7227	58.0	61.6	60.2	0.48	68.3	*	56.8	*
93 Mao-tzu-tou	37.0	62.0	—	0.37	32.0	67.0	48 8	0.32
107 Wan-li-hsien	35.3	62.6	62.3	0.36	36.0	74.6	50 6	0.38
132 PTB No. 16	40.0	62.6	58.4	0.39	37.0	60.6	50.3	0.38
125 Cody	34.0	63.3	—	0.35	41.0	113.0	35.5	0.27
100 Fu-chin-huang	38.0	63.3	69.0	0.38	33.6	70.6	53.9	0.32
98 Chung-chien No. 2	35.3	64.6	66.0	0.35	36.6	70.0	52.9	0.34
128 Blue Bonnet	58.0	64.6	75.8	0.47	68.3	152.0	76.4	0.31
124 Coiusa	50.3	65.6	64.0	0.43	68.3	*	77.5	*
101 Shui-pai-tiao	33.6	66.6	65.3	0.34	34.0	64.0	53.2	0.35
104 Tsao-ho No. 4	43.0	67.3	62.2	0.39	46.0	78.0	56.8	0.37
133 Indedsal Llinoy	40.0	68.0	59.0	0.37	34.0	69.3	51.0	0.33
94 Shengli-hsien	41.3	68.0	62.0	0.38	39.3	76.0	54.2	0.34

Appendix

(Continued 4)

Variety	First Crop Season				Second Crop Season			
	Photoperiod			Index of photo-sensitiveness	Photoperiod			Index of photo-sensitiveness
	9-hour	24-hour	Natural condition		9-hour	24-hour	Natural condition	
102 Tung-kuan-pai No. 18	—	69.0	—	—	38.0	82.3	58.5	0.32
110 Chianghsi No. 3613	48.6	69.3	—	0.41	37.0	80.6	57.4	0.31
16 Kaohsiung No. 18	56.6	69.3	57.8	0.45	51.3	113.0	49.1	0.31
172 No. 7220	47.0	70.3	57.7	0.40	51.3	88.0	52.9	0.37
111 Iliang-Tapaiku	37.3	71.6	80.3	0.34	36.0	84.0	59.1	0.32
166 No. 7157	55.3	74.0	—	0.43	67.0	123.6	60.3	0.35
69 Pai-chues-ko	47.0	75.0	74.0	0.38	48.0	77.6	60.7	0.38
59 Pan-tien-tzu	57.0	77.0	70.4	0.43	63.0	107.7	66.2	0.37
167 No. 7163	55.6	77.3	64.9	0.42	66.3	123.6	61.7	0.35
182 No. 7269	60.0	78.0	63.5	0.43	41.6	79.6	57.3	0.34
153 No. 7107	53.0	78.6	65.8	0.40	58.3	119.0	66.2	0.33
159 No. 7126	58.3	79.0	65.3	0.42	53.0	101.6	60.8	0.34
160 No. 7127	56.6	79.3	65.0	0.42	56.0	100.3	60.4	0.36
156 No. 7113	56.3	80.3	66.4	0.41	54.6	113.0	58.5	0.33
181 No. 7267	63.0	80.3	63.5	0.44	—	117.0	61.8	—
173 No. 7224	55.3	80.6	70.3	0.41	75.6	147.0	81.6	0.34
164 No. 7154	68.3	81.0	—	0.46	81.6	*	83.2	*
106 Chung-nung No. 34	54.0	81.5	73.2	0.40	57.0	122.0	66.1	0.32
169 No. 7165	49.6	83.0	62.9	0.37	55.6	103.3	60.8	0.35
171 No. 7186	51.0	84.0	73.6	0.38	56.3	109.0	68.0	0.34
155 No. 7111	54.3	85.6	65.0	0.39	59.0	*	64.1	*
175 No. 7237	68.3	86.0	84.0	0.44	82.0	*	52.6	*
180 No. 7252	68.3	88.6	86.5	0.44	73.0	148.5	92.1	0.33
122 Improved Blue Bonnet	67.0	91.0	80.4	0.40	52.3	83.6	49.8	0.38
179 No. 7251	65.3	91.3	—	0.42	67.6	*	75.4	*
178 No. 7248	70.3	93.0	—	0.43	78.3	*	87.7	*
158 No. 7121	63.6	99.0	82.0	0.39	77.0	*	95.0	*
170 No. 7184	62.0	100.0	79.7	0.38	53.0	93.6	59.4	0.36
183 No. 7270	70.3	107.0	92.6	0.40	79.0	*	87.9	*
163 No. 7151	59.0	—	—	—	66.3	145.5	70.0	0.31
Group IIb.								
118 Paichueh-hsiao-yu-chan	28.6	70.0	86.7	0.29	25.0	79.6	46.9	0.24
113 Che-chang-chung-hsien No. 1	30.6	71.3	39.5	0.30	38.6	135.0	35.8	0.29
119 Lungnan-shuangchiung-pai	28.6	73.0	—	0.28	30.0	84.3	48.6	0.26
38 Rikuu No. 20	24.0	73.3	35.3	0.25	33.0	151.5	35.5	0.18
116 Che-chang No. 9	29.0	75.3	98.0	0.28	27.3	79.3	47.3	0.26
*82 Yungan-fen-lung-tsao	35.3	75.3	51.5	0.29	—	—	—	—
49 Aikoku No. 1	25.0	77.0	33.7	0.25	32.6	126.6	35.9	0.20
97 Li-ku-tsao	33.0	77.0	—	0.30	35.0	77.6	51.8	0.31

Appendix

(*Continued 5*)

Variety	First Crop Season				Second Crop Season			
	Photoperiod			Index of photo-sensi-tiveness	Photoperiod			Index of photo-sensi-tiveness
	9-hour	24-hour	Natural condition		9-hour	24-hour	Natural condition	
131 Boenar	33.0	79.5	49.1	0.29	35.6	117.5	40.6	0.23
115 Fang-wan-hsien No. 21-3	30.0	79.6	89.0	0.27	25.0	98.0	45.3	0.20
184 No. 9781	36.3	81.3	50.0	0.31	37.0	90.3	47.0	0.29
121 Che-chang No. 3	30.0	81.3	—	0.27	29.6	127.3	48.5	0.19
109 Tu-chiang-yü	34.3	86.3	74.0	0.28	30.0	92.3	53.8	0.25
120 Pucheng-Wuchueh-pai	35.0	89.3	—	0.28	30.6	96.3	53.9	0.24
47 Norin No. 21	33.6	94.0	42.5	0.26	25.0	*	39.9	*
117 Fei-lai-feng	32.0	95.6	59.8	0.25	39.0	*	42.8	*
78 Shuang-chiang	29.0	98.0	129.3	0.23	33.3	124.0	57.6	0.21
71 Ko-tzu	30.6	99.0	130.0	0.24	33.0	*	60.4	*
177 No. 7245	38.3	99.3	86.7	0.28	37.0	*	43.2	*
51 Shinriki	29.6	101.0	59.7	0.23	36.0	118.6	43.3	0.23
52 Iwata-Asahi	29.0	102.6	47.0	0.22	36.0	137.6	40.7	0.21
151 No. 7043	31.0	103.0	69.4	0.23	57.6	113.0	63.6	0.34
126 Calora	33.6	105.7	42.8	0.24	38.0	148.0	39.3	0.20
72 Liu-chan	31.3	108.3	122.2	0.22	31.5	149.0	57.1	0.17
114 Chung-ta No. 345	31.3	112.6	48.9	0.22	34.6	*	41.9	*
67 Ti-chiao-meng-tang	27.0	113.7	154.3	0.20	27.6	149.0	62.5	0.16
76 Ya-mu	42.3	117.6	121.3	0.26	32.0	*	64.0	*
150 No. 7041	28.6	119.3	40.7	0.19	36.3	*	24.8	*
162 No. 7141	40.6	122.6	72.3	0.25	43.0	*	44.3	*
68 Shui-chin-chung	29.0	138.0	162.9	0.17	25.0	*	60.7	*
79 Man-tzu	30.5	140.0	165.6	0.18	30.3	*	64.6	*
75 Hsienlo	33.0	140.3	169.5	0.19	27.6	*	60.7	*
26 Taitung No. 24	46.3	185.0	57.6	0.20	61.0	*	50.5	*
134 Potik Tjem Poka	50.0	228.8	—	0.18	41.3	*	78.7	*
127 Texas Patna	66.3	230.0	88.0	0.22	77.3	*	86.6	*
135 Poetih Menek Don	40.5	233.0	—	0.17	32.0	*	78.7	*
90 Licheng-tien-pa-tzu	42.0	258.0	46.6	0.12	52.3	*	45.8	*
74 Chin-kuo-chan	—	—	173.8	—	—	—	64.4	—
Group IIc.								
136 Macan Banet	42.3	*	—	*	51.6	*	86.7	*
129 Rerocre	63.6	*	—	*	68.3	*	84.6	*

* The varieties in each group are arranged in the order of the days from the beginning of treatment to the beginning of heading under 24-hour photoperiod in the first crop.