THE PHOTOPERIOD IN SEVERAL VIETNAM VARIETIES OF RICE

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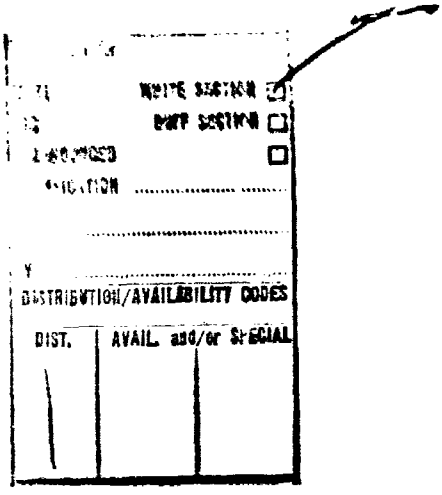

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THE PHOTOPERIOD IN SEVERAL VIETNAM VARIETIES OF RICE

/Following is the translation of an article by Bui Gui Dap, Director of the Agricultural and Forestry Institute in Hanoi and Ngiem Fu Shuan, Postgraduate Student (DRV, Democratic Republic of Vietnam, appearing in the Russian-language periodical Agrobiologiya (Agrobiology) No 2 (116), 1959, pages 220--230. It was translated from French by M. I. Rozenfeld. Translation from Russian performed by Sp/7 Charles T. Ostertag Jr./

In Vietnam, thanks to its tropical climate, rice can be cultivated at various times of the year. In Northern Vietnam it is sown and harvested primarily in the following periods: Sowing in November--December, harvesting in June; sowing in February--March, harvesting in June--July; sowing in May--June, harvesting in November. Since in Vietnam June is called the "fifth lunar morth," and November the "tenth lunar month," then rice which is cultivated during the stated three periods is designated as "fifth month," "spring" and "tenth month" rice.

Rice which is sown in various periods develops under different conditions of temperature, humidity, intensity of sunlight, length of day, etc. Therefore, there is interest in the study of the phase development of varieties which are cultivated during these three periods. From a practical point of view a knowledge of the periods of passing through the light stage /apparently light stage refers to a period during which photo-induction of flowering occurs, a period during which day-length is critical for flowering of photosensitive varieties/ by the various varieties of rice may help to determine the optimum date for the sowing of each variety and make agricultural technique more precise with the aim of increasing the harvest. From a theoretical point of view, a comparison of the duration of the photoperiod in varieties which are cultivated in various periods may yield several concepts concerning the influence of temperature and light in their interaction on the rice plant during its passage through the photo-sensitive period.

The present article presents a review of the materials of our first tests, which were begun in 1954. The objects of our investigations were the three varieties which were cultivated most often by us in the stated periods: The Nam Ninh variety as the "spring" rice, the Chiem Chanh variety as the "fifth month" rice, and the Tam Den variety as the "ten month" rice. The tests with each of these were conducted for several years in succession. Lack of space does not permit us to present the data of all the tests and we will limit ourselves to the results of the last test for each variety. However, these results supported the results of tests from previous years.

I. Procedure for the Tests

The tests were carried out in flower pots. Before sowing the seeds were moistened and allowed to germinate. The same number of seeds were sown in all the flower pots and subsequently the same number of plants were preserved. There were five pots in each variation of each test, in other words all the tests were set up in five replications. The variations differed in the conditions of light exposure, while the control plants were kept under natural daylight conditions all the time.

For determining the periods for the plants of each variety to pass through the light phase two methods of action were used: In one variation the plants were influenced for various periods of time by a short day (9 hours of light), and in another by uninterrupted (round the clock) days.

A comparison of the periods for the beginning and the duration of flowering of the plants in the various variations may produce some ideas on which conditions determine the passage of the light stage for each of the varieties studied by us which were cultivated at different times of the year.

II. Results of the Tests

A. "Tenth month" rice -- Tam Den variety (1956 tests)

In all the variations on the influence of short (9 hours) days and in the control to it the sowing was done on 2 July, and in the variations on the influence of uninterrupted (round the clock) illumination and in the appropriate control -- on 6 July.

In nine variations out of 17 the exposure to short days began on the fifth day following sowing, that is on 7 July, and lasted 7, 10, 13, 16, 19, 22, 25, 30 and 35 days. This means that, as an example, in the first of the variations the plants transferred again to a natural day after 7 days of exposure to short days, in the second -- after 10 days, etc. In the remaining eight variations the plants initially found a sufficiently prolonged period of time in a natural day, and exposure to short days was begun only after 75, 80, 83, 86, 89, 92, 95 and 100 days following sowing and lasted up until the formation of the flower buds.

In the tests of the influence of uninterrupted days, in nine variants out of 17 the round the clock illumination was provided immediately after sowing and lasted 12, 15, 18, 21, 24, 27, 30, 35 and 40 days. In the remaining eight variants the plants were found initially for a long time under the conditions of a natural day and the uninterrupted illumination was begun only after 75, 80, 83, 86, 89, 92, 95 and 100 days following sowing and lasted up until the moment of flowering. Besides this, in one variation the plants were found in uninterrupted illumination for the entire vegetative period.

Data on the periods of flowering in the different variants are presented in tables 1 and 2.

B. "Spring" rice -- Nam Ninh variety (1956 tests)

In all the variants the sowing was done on 10 March.

There were 13 variants of the reaction to short (9 hour) days.

In the control variants the plants were subjected to natural days all the time.

The results of the tests are shown in tables 3 and 4.

C. "Fifth month" rice -- Chiem Chanh variety

a) 1956/57 tests

In 12 variants of the reaction to short days and in the control to it the rice was sown on 16 January 1957. In seven of these variants the short-day treatment began with the fifth day following sowing and lasted 15, 20, 25, 30, 35, 40 and 45 days. Then the plants were again transferred to natural illumination. In one variant the short-day treatment lasted from the fifth day following sowing up until the formation of the flower buds. In the remaining four variants the plants were grown initially for a long time in natural illumination; the short-day treatments began only after 100, 110, 115 and 120 days following sowing.

In the variants of the reaction to uninterrupted days and the control to it the sowing was done on 28 December 1956. In seven of these an uninterrupted day was provided from the moment of sowing for a duration of 20, 25, 30, 35, 40, 45 and 50 days, after which the plants were transferred to natual day. In six of the variants the uninterrupted day was provided only after 100, 110, 115, 120, 125 and 130 days following sowing, and in one variant the plants were found in uninterrupted daylight all the time.

The controls were plants which were grown in a natural daylight condition from the moment of sowing.

The results of the tests are presented in tables 5 and 6.

b) 1957/58 tests

In order to obtain additional data on the Chiem Chanh variety we conducted two new tests with it in 1957/58. The aim of the first test was to determine more accurately the period for passing through the photo-sensitive stage, since in the tests of 1956/57 the duration of the treatment was insufficient. This time we used only the short-day treatment. In eight variants the reaction to it began after 15 days following sowing and lasted 5, 15, 25, 35, 45, 55, 65 and 75 days, and in five -- after 100, 110, 120, 130 and 140 days following sowing. The control plants were found under the conditions of a natural day for the entire time.

The date of sowing was 22 November.

In the second test we studied the influence of temperature and light in their interaction on the passing through of the light stage by the Chiem Chanh variety.

The sowing was carried out "gradually" from 14 October 1957 through 28 March 1958 in 12 periods with intervals of 15 days between each. Due to this the sprouts developed under various temperature conditions. There were two variants in the sowing of each period. In one the plants were in natural daylight all the time, and in the other they were subjected to a short, nine hour day, consequently in this respect they had favorable conditions for passing through the light stage.

The results of these two tests are presented in tables 7, 8 and 9.

III. Discussion

An analysis of the tables makes it possible to make several preliminary conclusions.

1. Though rice is a short day plant, that is it requires a short day for the successful passing through of the light stage, nevertheless the reaction of various varieties to uninterrupted or short days is not the same. For the tests we purposely selected varieties that are typical for the rice which is cultivated in North Vietnam in various periods: The "fifth month" Chiem Chanh variety, the period of development of which is very prolonged (from November-December through June); the "tenth month" Tam Den variety, also with a quite long period of development, taking place however only in the summer--fall months (June--November); the "spring" Nam Ninh variety with a very short period of development (from March through June).

a. With the Tam Den variety in the variant where uninterrupted day was provided for the entire vegetative period, not one plant bloomed (table 2). But in the variants where a short day was provided from the fifth day following sowing they bloomed 76 days earlier than the control*, if this influence lasted a month. And even if it lasted 16 days the test plants led the control by 56 days (table 1). The data presented indicate that the Tam Den variety reacts very strongly to both the uninterrupted and short day and is an expressed short day variety, as however, the majority of "tenth month" varieties.

b. Even the Chiem Chanh "fifth month" variety did not flower at all if it was subjected to uninterrupted day for the entire vegetative period. It also did not bloom in the event it initially was found for a long time in natural daylight and was subjected to the influence of uninterrupted daylight only after 100 days following sowing (table 6). Chiem Chanh is also a short day variety, as also are many other varieties of "fifth month" rice.

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* Here and subsequently the comparison with the control always relates to the date of flowering of 50% of the plants (Editor's comment).

c. In contrast to this, the plants of the Nam Ninh variety all bloomed, though 24 days later than the control, if they were found in uninterrupted daylight from the moment of sowing to ripening (table 4). In the variant in which the influence to short days lasted from the fifth day following sowing up until the formation of the flower buds, they led the control in the period of flowering by only four days (table 3). Apparently this variety with a short development cycle is less sensitive to uninterrupted daylight and reacts more weakly to a short day than both of the previous varieties.

Thus, these three varieties -- typical representatives of the "spring", "fifth month" and "tenth month" varieties of rice -- present various requirements for the conditions of illumination for passing through the light stage. Varieties with a long development cycle (Tam Den and Chiem Chanh) require a short day, while the "spring" variety with a short development cycle may become adapted both to the uninterrupted and to the short day. From here it follows that if we want to cultivate rice in Vietnam several times a year in the same area, then preference must be given to varieties with a short cycle of development as more pliable and more adaptable.

2. a. With the Tam Den variety, which was subjected to the influence of short days starting with the fifth day following sowing, flowering of 50% of the plants took place 56 days earlier than in the control, if the influence lasted for 16 days. However the last plant nevertheless in this case bloomed 19 days later than the last plant in the control. If the influence lasted for 19 days then flowering of all the plants took place earlier than in the control; on the average they led the control by 68 days. They led the control all the more if the influence to short days lasted for 22--35 days. But if it lasted only 7, 10, and 13 days, then the blooming took place later than in the control (table 1).

A different picture was observed in variants in which the exposure to short days began in later periods. Only in the variant in which short days were provided in 75 days following sowing did the flowering of 50% of the plants take place one day earlier than in the control. But if the short day was produced in 80, 83, 85 and more days following sowing, then the flowering of 50% of the plants was observed later than in the control.

In comparing the data which is presented in table 1, it can be assumed that in the Tam Den variety the photo-sensitive phase begins with the 20th and 23rd day following sowing. At the same time the figures in table 2 indicate that an uninterrupted day, if it is provided in a period of 40 days following sowing, did not inhibit flowering, but even partially accelerated it, reducing along with this the total duration of this process. It can be apparently concluded from this that an uninterrupted day, given in the first days of passing through the light phase, acts on the development of the Tam Den variety not as an inhibitor but as a stimulant, particularly under the conditions of a nigh summer temperature. On the other hand, plants of this variety did not bloom at all in the variant in which they were influenced by an uninterrupted day beginning after 75 days following sowing.

If the same influence was begun still later -- in 80, 83, etc. days following sowing, then the plants nevertheless set about flowering, though with difficulty. It may be conjectured that the Tam Den variety is particularly sensitive to an uninterrupted day in the end of passing through the light period.

b. As regards the Nam Ninh "spring" variety, then neither the short nor the uninterrupted day exert a clearly expressed influence on it (tables 3 and 4). Having been exposed to both influences in various periods up until the lapse of the first 24 days after sowing, it was somewhat late in flowering in comparison with the control. If both influences began in 45 and 48 days following sowing or a little later (after 51 days), then it flowered somewhat earlier than the control under the influence of the short day and a little later under the influence of the uninterrupted day. But in 54 days following sowing neither the short nor the uninterrupted day exerted a specific effect on it. It can be concluded from here that in this variety the photo-sensitive phase ends between the 54th and 57th days following sowing.

c. In contrast to the "tenth month" and "spring" varieties, in the Chiem Chanh "fifth month" variety a considerable part of the vegetative period takes place in the winter months. Being subjected to the influence of both short and uninterrupted days in various periods up to the lapse of 50 days (tables 5 and 6) or the influence of the short day up to the lapse of 90 days following sowing (table 7), it flowered on approximately the same dates as the control. If the influence was begun in 100 days following sowing, then under the influence of the uninterrupted day not one plant bloomed (table 6), and under the influence of the short day all the plants bloomed and on the average they flowered two days earlier than the control in the 1956/57 tests and seven days earlier in the 1957/58 tests (tables 5 and 7). It must be noted that in the 1956/57 tests the sowing was done earlier than in the 1957/58 tests.

If the plants received the uninterrupted day in 125 and 130 days following sowing, and the short day -- in 130 days, then a noticeable reaction was not observed in them yet. It can be concluded from here that with the Chiem Chanh during its normal sowing period the photo-sensitive phase begins between the 90th and 100th day and ends between the 125th and 130th day following sowing.

3. Since with "fifth month" rice, one of which is the Chiem Chanh variety, development proceeds during various times of the year -- in the winter, spring, summer, that is, under conditions of a changing temperature, it is possible to judge the action of temperature and light conditions in their interference on the passing through of the light phase by this variety. In the test of the "gradual" sowing and cultivation of the plants, all the time for the natural day (table 8) the cycle of development lasted longest of all in the earliest fall sowing and was cut in half in the last sowing, conducted in the spring of the following year: In the sowing of 14 October 50% of the plants bloomed only after 188 days, and in the sowing of 28 March -- in 85 days.

The same regularity is noted in the Chiem Chanh variety in those variants of "gradual" sowing in which the plants were always found in the short day: In the sowing of 14 October 50% of the plants bloomed only after 160 days, and in the sowing of 28 March -- after 67 days.

On the whole the reaction to short days reduced the duration of development of the Chiem Chanh variety in the tests of "gradual" sowing. But if the variants are compared, the data presented in tables 8 and 9 on the flowering of plants from sowings of the same period, which were either left in the natural day or subjected to the influence of the short day, then it can be seen that the reaction of the variety to the short day depended on the temperature. In the sowing of 14 October (variant I), the plants which had received the short day flowered 28 days earlier than those which developed in the natural day. This means that the still high temperature of October made it possible for the Chiem Chanh variety to pass without difficulty through the light stage under the influence of a shorter day.

But in the sowings of the next four periods -- from 29 October through 13 December (variants II, III, IV and V), the plants which had received the short day differed less and less based on the date of flowering from those developing in natural illumination. In the sowings of 13 December the difference comprised only six days. This indicates that the comparatively low temperature of the winter months does not permit the plants to easily pass through the light phase. In the sowings which were conducted on 28 December and later the plants again fall in the end of March, in April and in May under the conditions of a considerably higher temperature, favorable for passing through the light phase, and in these variants the action of the short day again becomes clearer. Again the duration of development of the plants is noticeably shortened.

Thus the temperature specifically influences the passing through of the light phase by the Chiem Chanh variety. A low temperature does not allow it to pass through, even if it has the optimum conditions of illumination for this -- a short day. As a result of this, under natural conditions its light phase begins much later than with other varieties (Tam Den, Nam Ninh) -- only in 90-100 days after sowing, in spite of the fact that in November, December and January the natural day is the shortest in the year. Therefore, it is practically more advantageous in place of the "fifth month" rice with a prolonged cycle of development, which takes place partially in the winter months, to cultivate "spring" rice if there is sufficient irrigation. The "fifth month" rice, which is planted in November--December, ripens no earlier than the "spring" rice which is planted in March, but takes up the sowing area much longer and requires greater care.

Conclusions

The study of the light phase in three typical varieties of rice in North Vietnam by the method of the reaction to short and uninterrupted days showed the following:

The Nam Ninh variety, as the majority of varieties of "spring" rice with a short cycle of development, apparently is mildly sensitive to light conditions. It can bloom under the conditions of both the short and the uninterrupted day.

The "tenth" and "fifth" month varieties -- Tam Den and Chiem Chanh, with longer cycles of development, must have a short day for normal development.

For the Tam Den variety, developing in the spring and summer under the conditions of a high temperature, the light phase begins very early -- between the 20th and 23rd day following sowing, while for the Chiem Chanh variety, the development of which takes place first at a low winter temperature and then at a higher temperature in the spring and the beginning of summer, this phase begins much later -- only between the 90th and the 100th day following sowing.

The temperature has a very important significance for the passing through of the light phase by rice. In the winter months with a temperature of less than 20° of heat, the Chiem Chanh variety does not enter this stage, in spite of the short day. For this it requires the higher temperatures of the spring months.

The ~~results of our~~ investigations show that if under the conditions of North Vietnam ~~we want~~ to cultivate rice in the same area several times a year, then it is better to use varieties with shorter cycles of development, of the "spring" type, since they are more plastic, and become better adapted to various conditions of illumination. In view of the unfavorable conditions, in which the development of "fifth month" rice takes place, it is adviseable to gradually limit the cultivation of it and expand the sowing of the "spring" and "tenth month" rice.

Table 1

Flowering of Tam Den rice ("tenth month" rice) under the influence of short days. 1956 tests. Sowing on 2 July.

Influence to short days	Flowering of the first plant		Flowering of 50% of the plants		Flowering of the last plant		Total duration of flowering (days)	By how many days, 50% of the flowers bloomed	
	Date	No. days after sowing	Date	No. days after sowing	Date	No. days after sowing		earlier than control	later than control
From the 5th day following sowing for:									
7 days.....	27/X	117	18/XI	139	11/XII	162	46		25
10 "	26/X	116	5/XI	126	19/XII	170	55		12
13 "	17/VIII	46	30/X	120	16/XII	167	122		6
16 "	10/VIII	39	29/VIII	58	10/XII	161	123	56	
19 "	11/VIII	40	17/VIII	46	23/VIII	52	13	68	
22 "	9/VIII	38	14/VIII	43	25/VIII	54	17	71	
25 "	8/VIII	37	13/VIII	42	18/VIII	47	11	72	
30 "	8/VIII	37	9/VIII	38	15/VIII	44	8	76	
35 "	6/VIII	35	11/VIII	40	14/VIII	43	9	74	
In the following number of days following sowing:									
75	15/X	105	23/X	113	25/XI	146	42	1	
80	15/X	106	25/X	115	23/XI	144	40		1
83	16/X	106	2/XI	123	11/XII	162	57		9
86	22/X	112	4/XI	125	6/XII	157	46		11
89	20/X	110	12/XI	133	24/XI	145	36		19
92	18/X	108	1/XI	122	4/XII	154	47		8
95	20/X	110	13/XI	134	30/XI	151	42		20
100	20/X	110	25/X	115	20/XI	141	32		1
Control	19/X	109	24/X	114	21/XI	142	34		

Table 2

Flowering of Tam Den rice ("tenth month" rice) under the influence of uninterrupted days. 1956 tests. Sowing on 6 July.

Influence of uninterrupted days	% of plants which bloomed	Flowering of the first plant		Flowering of 50% of the plants		Flowering of the last plant		Total duration of flowering (days)
		Date	No. days after sowing	Date	No. days after sowing	Date	No. days after sowing	
Immediately after sowing for:								
12 days	100	19/X	105	23/X	109	26/X	112	8
15 "	100	17/X	103	22/X	108	25/X	111	9
18 "	100	18/X	104	22/X	108	26/X	112	9
21 "	100	16/X	102	22/X	108	27/X	113	12
24 "	100	16/X	102	23/X	109	25/X	111	10
27 "	100	17/X	103	22/X	108	23/X	109	7
30 "	100	18/X	104	20/X	106	24/X	110	7
35 "	100	18/X	104	20/X	106	29/X	115	12
40 "	100	17/X	103	22/X	108	26/X	112	10
In the following number of days after sowing:								
75	0							
80	20	30/X	116					
83	20	2/XI	119					
86	20	29/X	115					
89	20	9/XI	126					
92	20	27/X	113					
95	20	25/X	111					
100	27	29/X	115					
From the first up to the last day of the vegetative period.....	0							
Control	100	30/X	116	10/XI	127	1/XI	148	33

Table 3

Flowering of Nam Ninh rice ("spring" rice) under the influence of short days. 1956 tests. Sowing on 10 March.

Influence of short days	Flowering of the first plant		Flowering of 50% of the plants		Flowering of the last plant		Total duration of flowering (days)	By how many days, 50% of the flowers bloomed	
	Date	No. days after sowing	Date	No. days after sowing	Date	No. days after sowing		earlier than control	later than control
From the 5th day following sowing for:									
4 days	8/V	69	21/V	72	30/V	81	13		1
7 "	20/V	71	21/V	72	30/V	81	11		1
10 "	20/V	71	21/V	72	23/V	74	4		1
13 "	21/V	72	22/V	73	23/V	74	3		2
16 "	19/V	70	22/V	73	1/VI	83	14		2
19 "	19/V	70	23/V	74	2/VI	84	15		3
In the following number of days following sowing:									
45	16/V	67	17/V	68	25/V	76	10	3	
48	16/V	67	17/V	68	25/V	76	10	3	
51	17/V	68	19/V	70	27/V	78	11	3	
54	17/V	68	19/V	70	21/V	72	5	1	
57	18/V	69	19/V	70	31/V	82	14	1	
60	19/V	70	20/V	71	29/V	80	11		
From the 5th day following sowing up to formation of flower buds	14/V	65	16/V	67	21/V	72	8	4	
Control	18/V	69	20/V	71	23/V	74	6		

Table 4

Flowering of Nam Ninh rice ("spring" rice) under the influence of uninterrupted days. 1956 tests. Sowing of 10 March.

Influence of uninterrupted days	Flowering of the first plant		Flowering of 50% of the plants		Flowering of the last plant		Total duration of flowering (days)	By how many days 50% of plants bloomed later than control
	Date	No. days after sowing	Date	No. days after sowing	Date	No. days after sowing		
Immediately after sowing for								
9 days	19/V	70	21/V	72	27/V	78	9	1
12 "	17/V	68	21/V	72	22/V	73	6	1
15 "	12/V	63	21/V	72	27/V	78	16	1
18 "	14/V	65	21/V	72	26/V	77	13	1
21 "	17/V	68	21/V	72	27/V	78	11	1
24 "	19/V	70	21/V	72	27/V	78	9	1
In the following number of days following sowing:								
45 days	12/V	73	2/VI	84	7/VI	89	17	13
48 "	19/V	70	24/V	75	1/VI	83	14	4
51 "	22/V	73	24/V	75	31/V	82	10	4
54 "	19/V	70	21/V	72	27/V	78	9	1
57 "	18/V	69	20/V	71	30/V	81	13	
60 "	17/V	68	21/V	72	22/V	73	6	1
From the moment of sowing up until moment of ripening	7/VI	89	13/VI	95	Only 80%	bloomed		24
Control	18/V	69	20/V	71	22/V	73	5	

Table 5

Flowering of the Chiem Chanh rice ("fifth month" rice) under the influence of short days. 1957 tests. Sowing on 16 January.

Influence of short days	Flowering of the first plant		Flowering of 50% of the plants		Flowering of the last plant		Total duration of flowering (days)	By how many days 50% of the flowers bloomed	
	Date	No. days after sowing	Date	No. days after sowing	Date	No. days after sowing		earlier than control	later than control
From the 5th day following sowing for:									
15 days	27/V	131	29/V	133	30/V	134	4		4
20 "	24/V	128	27/V	131	29/V	133	6		2
25 "	25/V	129	28/V	132	29/V	141	13		3
30 "	23/V	127	26/V	130	29/V	133	7		1
35 "	24/V	128	25/V	129	28/V	132	5		
40 "	25/V	129	27/V	131	28/V	132	4		2
45 "	24/V	128	25/V	129	28/V	132	5		
From the 5th day following sowing up to formation of flower buds	18/V	122	20/V	124	26/V	130	9	5	
In the following number of days following sowing:									
100	23/V	127	23/V	127	25/V	129	3	2	
110	20/V	124	25/V	129	28/V	132	9		
115	24/V	128	25/V	130	28/V	132	5		1
120	25/V	129	26/V	130	28/V	132	4		1
Control	21/V	125	25/V	129	31/V	135	11		

Table 6

Flowering of Chiem Chanh rice ("fifth month" rice) under the influence of uninterrupted days. 1956/57 tests. Sowing on 18 December 1956.

Influence of uninterrupted days	Flowering of the first plant		Flowering of 50% of the plants		Flowering of the last plant		Total duration of flowering (days)	By how many days 50% of the flowers bloomed	
	Date	No. days after sowing	Date	No. days after sowing	Date	No. days after sowing		earlier than control	later than control
From the moment of sowing for:									
20 days	14/V	137	20/V	143	29/V	143	7		4
25 "	13/V	136	15/V	138	20/V	143	8		
30 "	11/V	134	14/V	137	21/V	144	11	2	
35 "	11/V	134	15/V	138	17/V	140	7	1	
40 "	13/V	136	17/V	140	21/V	144	9		1
45 "	10/V	133	14/V	137	17/V	140	8	2	
50 "	13/V	136	14/V	137	18/V	141	6	2	
In the following number of days following sowing:									
100	NOT ONE PLANT BLOOMED								
110	20/V	143	Only 20% of all		the plants bloomed				
115	14/V	137	22/V	145	28/V	151	15		6
120	21/V	144	24/V	147	28/V	151	8		8
125	9/V	132	18/V	141	20/V	143	12		2
130	15/V	138	18/V	141	22/V	145	8		
Throughout the entire vegetative period .	NOT ONE PLANT BLOOMED								
Control	12/V	136	16/V	139	20/V	143	9		

Flowering of Chiem Chanh rice ("fifth month" rice) under the influence of short days. 1957/58 tests. Sowing of 22 November 1957.

Influence of short days	Flowering of the first plant		Flowering of 50% of the plants		Flowering of the last plant		Total duration of flowering (days)	By how many days 50% of the flowers bloomed	
	Date	No. days after sowing	Date	No. days after sowing	Date	No. days after sowing		earlier than control	later than control
From the 15th day following sowing for:									
5 days	23/IV	152	24/IV	153	27/IV	156	5	1	
15 "	25/IV	154	25/IV	154	4/V	163	10		
25 "	24/IV	153	25/IV	154	30/IV	159	7		
35 "	21/IV	150	24/IV	153	25/IV	154	5	1	
45 "	23/IV	152	25/IV	154	27/IV	156	5		
55 "	22/IV	151	25/IV	154	29/IV	158	8		
65 "	23/IV	152	23/IV	155	27/IV	156	5		1
75 "	24/IV	153	25/IV	154	26/IV	155	3		
In the following number of days following sowing:									
100	17/IV	146	18/IV	147	21/IV	150	5	7	
110	19/IV	148	20/IV	149	23/IV	152	5	5	
120	21/IV	150	21/IV	150	23/IV	152	3	4	
130	23/IV	152	25/IV	154	2/V	161	10		
140	21/IV	150	25/IV	154	30/IV	159	10		
Control	24/IV	153	25/IV	154	1/V	160	8		

Table 8

Flowering of Chiem Chanh rice, sown in 1957--58 in various periods with intervals of 15 days and kept in natural light all the time.

Variants	Date of sowing	Flowering of the first plant		Flowering of 50% of the plants		Flowering of the last plant	
		Date (1958)	No. days after sowing	Date (1958)	No. days after sowing	Date (1958)	No. days after sowing
I	14/X 1957	16/IV	184	20/IV	188	21/IV	189
II	29/X "	18/IV	171	20/IV	173	22/IV	175
III	13/XI "	21/IV	159	23/IV	161	24/IV	162
IV	28/XI "	23/IV	146	24/IV	147	25/IV	148
V	13/XII "	23/IV	131	27/IV	135	30/IV	138
VI	28/XII "	4/V	127	6/V	129	11/V	134
VII	12/I 1958	14/V	122	22/V	130	29/V	137
VIII	31/I "	21/V	110	24/V	113	30/V	119
IX	13/II "	24/V	100	26/V	102	31/V	107
X	27/II "	25/V	87	31/V	93	3/VI	96
XI	13/III "	8/VI	87	13/VI	92	17/VI	95
XII	28/III "	18/VI	82	21/VI	85	25/VI	89

Table 9

Flowering of Chiem Chanh rice, sown in 1957--58 in various periods with intervals of 15 days and subjected to short days all the time.

Variants	Date of sowing	Flowering of the first plant		Flowering of 50% of the plants		Flowering of the last plant		By how many days 50% of the plants bloomed earlier than those kept in natural light
		Date	No.days after sowing	Date	No.days after sowing	Date	No.days after sowing	
I	14/X 1957	20/III	157	23/III	160	30/III	167	28
II	29/X "	2/IV	155	8/IV	161	11/IV	164	12
III	13/XI "	11/IV	149	12/IV	150	14/IV	152	11
IV	28/XI "	14/IV	137	16/IV	139	21/IV	144	8
V	13/XII "	18/IV	126	21/IV	129	22/IV	130	6
VI	28/XII "	22/IV	115	24/IV	117	26/IV	119	12
VII	12/I 1958	29/IV	107	2/V	110	12/V	120	20
VIII	21/I "	3/V	92	7/V	96	17/V	106	17
IX	13/II "	8/V	81	12/V	88	20/V	96	14
X	27/II "	20/V	82	22/V	84	25/V	87	9
XI	13/III "	24/V	72	27/V	75	29/V	77	17
XII	28/III "	1/VI	65	3/VI	67	8/VI	72	18