THE EFFECT OF TEMPERATURE ON A DESYNAPTIC GENE IN RICE

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Introduction

Since Beadle (1930) first found an asynaptic mutant in maize, gene-controlled asynapsis or desynapsis has been observed and reported in many plant genera. Several theories concerning the mechanism of asynapsis or desynapsis have been proposed (see Swaminathan and Marty, 1959), but none of them has been proved with certainty.

Results reported in asynapsis or desynapsis showed that almost in all cases there were great variabilities in the amount of asynapsis or desynapsis. In those cases to which extensive work had been done, such variabilites were usually attributed either to environmental causes or to modifying gene(s) or both.

The effect of temperature on asynapsis or desynapsis has been studied in some genera of plants. Thus Goodspeed and Avery (1939) reported that high temperature decreased the pairing of chromosomes and low temperature favored the formation of bivalents in an asynaptic mutant of *Nicotiana sylvestris*. While in a desynaptic mutant of common wheat, Li *et al.* (1945) found that high temperature enhanced the bivalent formation and low temperature induced more desynapsis. Both of their interpretations of results were mainly based on the material collected in the field. After the frequencies of cells with varying numbers of bivalents at diakinesis or first meiotic metaphase were determined for each plant they were correlated with the air temperatures recorded at the time of fixation or of the preceding day.

Such studies on the temperature effect on asynapsis or desynapsis were exploratory. A more rigid control of temperature and of other environmental factors seems to be necessary before a definite conclusion can be reached.

This paper concerns with the effect of temperature on a desynaptic gene in rice under controlled conditions. The desynaptic mutant was isolated from progenies treated with the thermal neutron (Chao *et al*, 1960). The desynaptic plants used for this study were cultivated in pots with their ratoons. In this way a relatively large number of plants could be tested. The potted plants

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were moved into the temperature and humidity-controlled rooms before onset of meiosis. Frequencies of cells with varying numbers univalents at MI were determined for individual spikes picked at different intervals from plants grown at different temperatures. Comparisons of the means of univalents were then made for different temperatures and for different intervals of the same temperature. Since humidity and other environmental factors were kept similar in different temperature-controlled rooms, differences in the means of univalents among different treatments could be attributed to temperature effect.

In order to discern the cause of desynapsis, a preliminary study on the content of the nucleic acid of the desynaptic plants and of their normal sibs was also made and reported in this paper.

Material and Methods

Ratooned shoots of the desynaptic plants of several R_3 segregating progenies grown in the field were transplanted into pots. Prior to the onset of meiosis, the potted plants of each progeny were divided at random into 4 groups. One group of plants kept outdoor was used as control. The other three groups of plants were brought into three separate temperature-controlled rooms and each of which maintained at a temperature of 20.0°±0.5° C, 25.0°±0.5° C, and 30.0°±0.5° C, respectively. All the plants were under the same condition of illuminations. The relative humidity was kept at 80 per cent at the respective temperature in each room. Two trials were made in this study. One was started at 10 A. M., Oct. 4, 1960 (Experiment 1) and the other at 10 A.M., Oct. 6, 1960 (Experiment 2). For each treatment, 12–16 plants were used.

Young spikes at the right stages were picked 12, 24, 48, and 96 hours after the plants were moved into the rooms. Materials from the indoor as well as the outdoor were fixed at the same time in the Farmer's fluid. PMC's were squashed and stained with acetocarmine. Number of univalents per cell was counted at MI and has been used to indicate the amount of desynapsis.

For nucleic acid analysis, young spikes were taken from both normal and desynaptic plants of a segregating progeny raised from ratoons in the field. Several spikes of a normal and a desynaptic plant of the same progeny were picked at the same time and fixed immediately in the Carnoy's fluid. These were used as paired samples. For each sample, 450 mgs. of young florets of relatively same size were taken for nucleic acid analysis. Ogur-Rosen's procedure for nucleic acid extraction (1950) was adopted and the nucleic acid content was measured by the ultraviolet spectrophotometer.

Results

Inheritance of the desynaptic character

The desynaptic type described in this paper was first noted in a small R_2

segregating population, homozygous for a recessive gene arisen from thermal neutron irradiation. Varying numbers of univalents were observed at diakinesis and MI in the PMC's of such desynaptic plants as well as in their vegetatively propagated progenies. The fertility of the desynaptic plants was very low, being ranged from 0.1 to 0.9 per cent (normal sibs 80.1 to 95.0 per cent). This indicates that desynapsis is also operating during megasporogenesis. Low fertility has been used as a diagnostic character to distinguish the desynaptic plants from their normal sibs.

Additional genetic data were obtained from the R_3 progenies grown in the first crop season of 1960. Thirty-one R_3 progenies from the normal plants of the R_2 segregating population were planted at that time, and segregation for desynaptic plants was scored on the basis of fertility. Among the 31 progenies, 11 showed no segregation for desynapsis, indicating that they were normal homozygotes. Segregation for normal and desynaptic plants was observed in each of the remaining 21 progenies (Table I). Thus, a ratio of 1 normal homozygote: 2 heterozygotes is indicated in the R_3 progenies being tested.

Table 1. Segregtion for desynapsis in 21 R_3 segregating progenies descended from the fertile plants of the R_2 segregating population

Progeny No.	No. of not desynaptic plants	No. of desynaptic plants
410-4- 1	54	25
- 4	50	30
- 5	68	12
- 6	61	19
- 7	67	11
- 9	56	12
-10	61	18
-11	48	12
-13	68	12
-14	52	7
-15	65	15
-18	64	14
-19	32	18
-20	60	19
-23	54	24
-28	42	18
-29	58	22
-30	54	14
-31	44	14
-32	48	30
Total	1,106	346
Exp. 3:1	1,089	363
Dev.	17	17

The twenty-one segregating progenies gave a total of 1452 plants, of which

1106 were normal and 346 desynaptic (Table I). The segregation fits a 3:1 ratio very closely.

The desynaptic gene has been designated as *ds*. Work is being carried on to group this gene in certain linkage group of rice.

The effect of temperature on desynapsis

Two experiments were conducted in this study. As the means of univalents determined from individual treatments in the first and second experiment are different, it is for this reason that the data obtained from these two experiments are kept separate and tabulated in Tables II and III, respectively. A more clear-cut result is obtained in the first experiment than in the second. The cause of the difference will be explained later. In spite of this difference, however, the general trend of the effect of temperature on the desynaptic gene, as indicated by the number of univalents at MI, is similar in both experiments.

Table 2. The effect of temperatures on univalent frequency at MI in PMC's of the desynaptic plants after various durations of treatment-Experiment 1

Treatment	Progeny & plant number	Number of univalents per PMC												Total No. of PMC's counted	Mean of univalents
		0	2	4	6	8	10	12	14	16	18	20	22		
12 hours															
Out door 16.8°-27.0°C*	4- 1			1	2	9	5	8	2					27	9.70
	5- 1	1	1	2	9	10	3	2						28	7.77
	5- 2			3	1	3	1	2	1					11	8.18
	Total	1	1	6	12	22	9	12	3					66	8.33
20.0°±0.5°C	1-12			1	5	11	7	4	1					29	8.76
	4-11					2	10	3	2					17	10.59
	4-12			1	4	6	4	1						16	8.00
	4-15	1			1	4	2	9	3					20	10.40
	5-13			1	1	3	5		2					12	9.33
	Total	1		3	11	26	28	17	8					94	9.38
25.0°±0.5°C	6-25		1	1		4	1	4	2					13	9.54
	9-22					1	5	5						11	10.72
	Total		1	1		5	6	9	2					24	10.08
30.0°±0.5°C	6-31		1			4	2							7	7.71
	6-35		1	2	3	8	3							17	7.17
	Total		2	2	3	12	5							24	7.33
24 hours															
Out door 20.5°-28.0°C*	4- 1			2		4	10	2	2					20	9.60
	5- 4		1		2	4	1	2	1					11	8.55
	5- 7			1		4	3	1						9	8.66
	6- 1	1		1	3	5	8	2	1					21	8.57
	9- 1					6	3	3	1	1	1			15	10.80
	Total	1	1	4	5	23	25	10	5	1	1			76	9.28
20.0°±0.5°C	1-12	1	2		1	6	8	4	1	2				25	9.28
	4-12			1	1	5	4	4	2					17	9.71
	4-14		2	1	1	3	2	1		1				11	7.81
	4-15			1		3	4	4	1					13	10.00
	5-13		1	5	3	4	5	2						20	7.30
	Total	1	5	8	6	21	23	15	4	3				86	8.83

Table 2. (Continued)

Treatment	Progeny & plant number	Number of univalents per PMC												Total No. of PMC's counted	Mean of univalents
		0	2	4	6	8	10	12	14	16	18	20	22		
25.0°±0.5°C	4-21			2	7	12	1							22	7.09
	6-21		1	5	9	8	2							25	6.40
	6-22			2	4	6	4	1						17	7.76
	Total		1	9	20	26	7	1						64	7.00
30.0°±0.5°C	4-32		4	7	2	3	1							17	4.82
	5-31		3		3	4	2							12	6.33
	6-31	2	1	3	4	3	1							14	5.14
	6-32	1	1		5	3	1							11	6.00
	Total	3	9	10	14	13	5							54	5.48
48 hours															
Out door	6- 1	2	1	4	4	9	4	2	1					27	7.11
18.6°-27.3°C*	7- 1			1	6	7	8	2	2					26	8.77
	Total	2	1	5	10	16	12	4	3					53	7.92
20.0°±0.5°C	4-15			2	8	6	5							21	7.33
	5-12				2	4		3						9	8.88
	5-13				3	6	6	7	2	1				25	10.16
	9-12			1	3	3	11	7						25	9.60
	Total			3	16	19	22	17	2	1				80	9.10
25.0°±0.5°C	4-21	2	5	14	1	4	3							29	4.62
	6-21		5	8	5	4	4							26	5.54
	6-23	4	6	2	8	1	3	1						25	4.72
	Total	6	16	24	14	9	10	1						80	4.95
30.0°±0.5°C	4-35	5	9	5	5	1								25	3.04
	6-32	3	14	2	1									20	2.10
	6-33	7	10	7	2	1								27	2.52
	Total	15	33	14	8	2								72	2.58
96 hours															
Out door	4- 1	1	3	3	1	6	6	3	1	1				25	7.92
16.5°-25.0°C*	4- 4	2	2	3	10	2	4	9	5	3		2	1	43	9.76
	Total	3	5	6	11	8	10	12	6	4		2	1	68	9.08
20.0°±0.5°C	1-12		1	2	3	6	5	5						22	8.45
	1-13				1	2	4	3						10	9.80
	4-12		2	6	5	5	10	2	2					32	7.81
	9-12		3	3	12	4	5	2	1					30	7.00
	Total		6	11	21	17	24	12	3					94	7.91
25.0°±0.5°C	4-24	4	9	7	2	3	3							28	4.00
	6-22	7	9	5		2		1	1					25	3.20
	6-23	4	12	8										24	2.33
	6-24	7	11	8		1	1	1	1					30	3.27
	Total	22	41	28	2	6	4	2	2					107	3.23

* Max.-Min. temperatures on preceding day.

The following facts render the author to conclude that the variability of desynapsis observed in this study bears no relation with the modifying gene(s):

(1) The data given in Tables II and III show that in each treatment no great differences in the average numbers of univalents among plants of different progenies were found.

(2) The fertilities of all the desynaptic plants of different R_3 progenies grown in the field were similar and very low, being less than 1 per cent.

(3) This mutant was arisen from a pure variety, Chainan No. 8, and cytogenetic studies have been undertaken in its R_2 and R_3 progenies and no segregation for characters other than desynapsis has been observed.

Table 3. The effect of temperatures on univalent frequency at MI in PMC's of the desynaptic plants after various durations of treatment—Experiment 2

Treatment	Progeny & plant number	Number of univalents per PMC												Total No. of PMC's counted	Mean of univalents
		0	2	4	6	8	10	12	14	16	18	20	22		
12 hours															
Out door	6- 5		8	7	6	8	1							30	5.13
18.6°-27.3°C*	6- 2	2	2	5	4	3	2	1						19	5.47
	9- 5	1	9	5	3	3	2							23	4.35
	Total	3	19	17	13	14	5	1						72	4.97
20.0°±0.5°C	6-13	3	11	6	9	4	1							34	4.17
	Total	3	11	6	9	4	1							34	4.17
30.0°±0.5°C	5-34	4	8	5	5		1							23	3.30
	5-35	1	4	7	4	2	2	1						21	5.14
	5-36	6	9	7	2	3								27	3.04
	Total	11	21	19	11	5	3	1						71	3.74
24 hours															
Out door	1- 1	2	5	2	3	9	4	4	1					30	7.00
16.6°-24.0°C*	4- 5		5	5	6		2		2					20	5.70
	4- 2		3	7	2	12	3	2						29	6.76
	Total	2	13	14	11	21	9	6	3					79	6.58
20.0°±0.5°C	1-15	3	2	6	7	3	2	2		2				27	6.29
	1-16	1	3	1	3	6	8	2	2					26	8.00
	6-13		5	1	1	2	1	3						13	6.30
	7-12	3	6	6	4	6	4		2					31	5.67
	Total	7	16	14	15	17	15	7	4	2				97	6.55
25.0°±0.5°C	1-23	1	2	6	11	6	2	1						29	6.00
	1-26	6	4	6	6	2	2							26	4.00
	7-21	3	4	7	2	4	1							21	4.23
	7-22			2	2	2	1	1						8	7.25
	7-23	1	1	1	8	6	1	3						21	7.05
	9-24		2	3	3	2	3							13	6.15
	Total	11	13	25	32	22	10	5						118	5.54
30.0°±0.5°C	1-31	4	12	10	2	1								29	2.89
	1-32	7	1	1	1									10	1.20
	5-35	10	9	6										25	1.68
	10-35	5	12	7	3									27	2.59
	Total	26	34	24	6	1								91	2.28
48 hours															
Out door	4- 1	1	3	3	1	6	6	3	1	1				25	7.92
16.5°-25.0°C*	4- 4	2	2	3	10	2	4	9	5	3		2	1	43	9.76
	Total	3	5	6	11	8	10	12	6	4		2	1	68	9.08
20.0°±0.5°C	I-16	2	3	3	4	8	4	1	2	1				28	7.21
	6-13	4	4	9	7	1	4	2						31	5.16
	7-12	1	5	4	3	7	5	1	2					28	6.80
	7-13	1	5	5	7	3	1	1						23	5.13
	10-12	3	6	10	3	5	3	1						31	4.90
	Total	11	23	31	24	24	17	6	4	1				141	5.10
25.0°±0.5°C	1-25	4	1	5	3	1	2							16	4.25
	7-22	4	4	2	2	2	1	1						16	4.12
	7-23	3	4	5	3	2	2							19	4.31
	Total	11	9	12	8	5	5	1						51	4.23
30.0°±0.5°C	1-31	1	2	4	1									8	3.25
	1-33	9	7	8	5	2	1							32	3.18
	5-34	3	4	1	1									9	2.00
	Total	13	13	13	7	2	1							49	2.97

Table 3. (Continued)

Treatment	Progeny & plant number	Number of univalents per PMC												Total No. of PMC's counted	Mean of univalents
		0	2	4	6	8	10	12	14	16	18	20	22		
96 hours															
Out door 18.5°-23.2°C*	1- 7	2	6	2	3	4	2	1		1				21	5.61
	1- 8		2	1	8	2								13	5.54
	Total	2	8	3	11	6	2	1		1				34	5.58
20.0°±0.5°C	6-13		2	5	3	2								12	4.83
	7-12	2	1	2	5	4	3	5			1			23	7.82
	Total	2	3	7	8	6	3	5			1			35	6.80
25.0°±0.5°C	7-23	6	5	6	6	3	2	2						30	4.60
	10-26		3	3	3	6	1							16	5.87
	Total	6	8	9	9	9	3	2						46	5.04

* Max.-Min. temperatures on preceding day.

The desynaptic plants of the same and different progenies used in this study seemed to have the same genic background. For this reason, the means of univalents of sevaral plants in a treatment have been used to interpret the results and the total frequencies of PMC's of several plants of individual treatments have been used to plot the distribution curves presented in Fig. 1.

The data presented in Tables II and III and Fig. 1 indicate that for each duration, except 12-hour, the mean number of univalents is significantly greater at low temperatures than at high temperatures. Taking the consideration of the second experiment, for example, after the desynaptic plants moved into the temperature-controlled rooms for 24 hours, the mean number of univalents is 2.28 at 30° C, 5.54 at 25°C, and 6.55 at 20°C. The mean number of univalents of the control material is similar to that at 20°C (6.58 vs. 6.55). This would be expected since the average temperature on the preceding day (Oct. 6, 1960, Table IV) was 20.3° C (16.6°–24.0° C) and the relative humidity was 80 per cent (65–95 per cent). With a few exceptions, this trend holds true for most of the durations. Since the relative humidities and other factors were similar in all the three rooms, difference in the amount of desynapsis observed in the plants grown at different temperatures may be attributed to the difference in temperatures. The results show that high temperature will favor the pairing of chromosomes and low temperature will induce more desynapsis in this mutant, a case similar to that reported by Li *et al.* (1945) in a desynaptic wheat.

It has been mentioned above that the means of univalents obtained in the two experiments are different. Generally, greater means of univalents are obtained in the first experiment than in the second in most of the comparable treatments.

The temperatures and humidities from Oct. 1 to Oct. 10, 1960 recorded by the Taiwan Provincial Agricultural Research Institute having a distance less than 1/4 mile from the experimental field, are given in Table IV. From the table, it can be seen that the average temperature on two preceding days of initiating the experiments was lower in the first experiment than in the second one (21.0° C vs. 23.1° C). It would be possible that differences in air

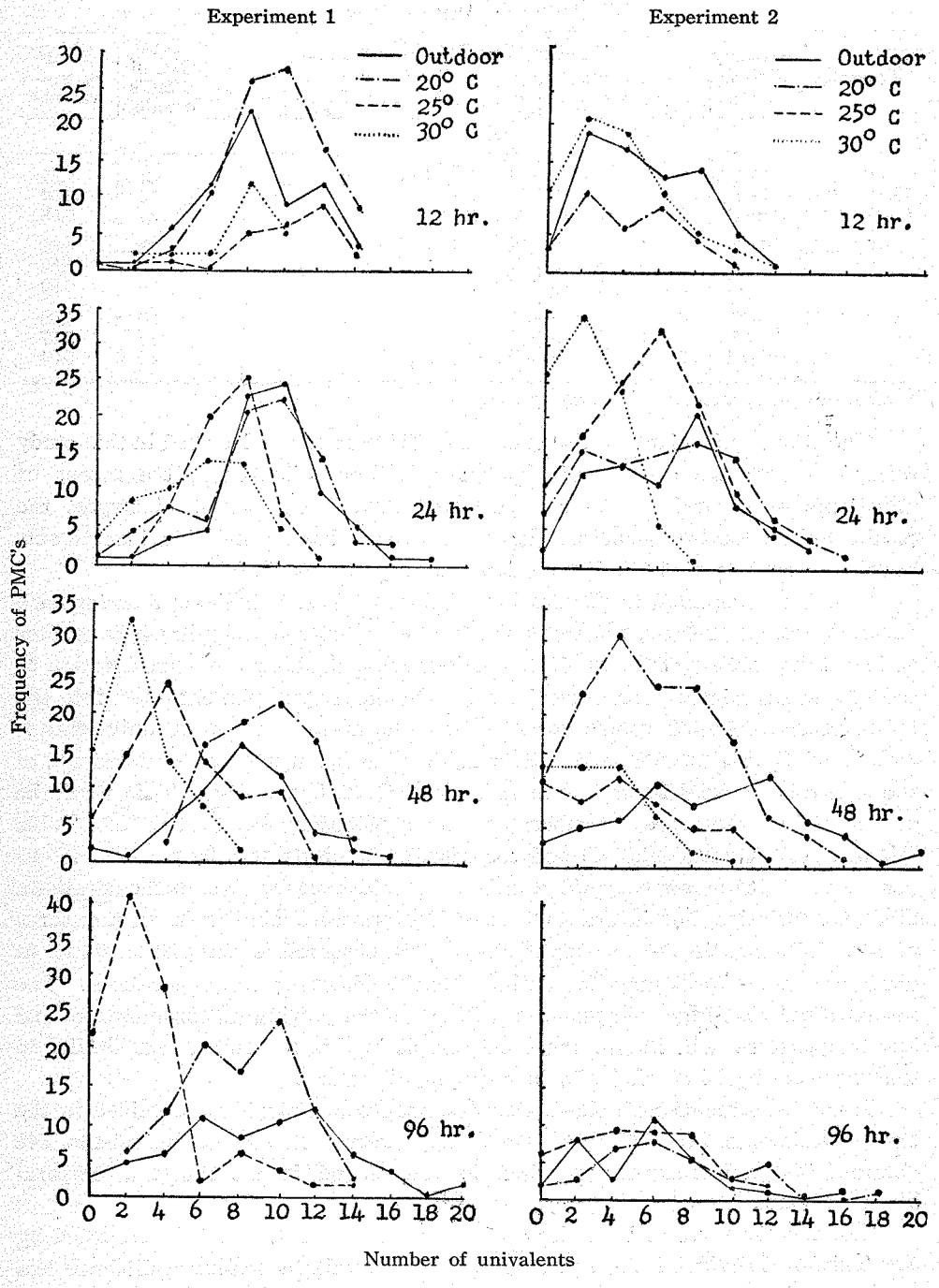

Fig. 1. Frequency of PMC's with varying number of univalents at MI in the desynaptic plants grown at different temperatures and intervals.

Table 4. Outdoor temperature and humidity during experiments (Oct. 1–Oct. 10, 1960) as recorded by Taiwan Provincial Agricultural Research Institute within 1/4 mile of the experimental field

Date	Temperature° C			Humidity %		
	Min.	Max.	Average	Min.	Max.	Average
Oct. 1	20.0	26.8	23.4	80	96	88
2	18.3	21.7	20.0	76	94	85
3	16.8	27.0	21.9	62	95	78.5
4	20.5	28.0	24.3	60	88	74
5	18.6	27.3	23.0	62	93	77.5
6	16.6	24.0	20.3	65	95	80
7	16.5	25.0	20.8	72	96	84
8	18.5	22.0	20.3	82	94	88
9	18.5	23.2	20.9	82	94	88
10	20.5	25.0	22.8	70	92	81

temperatures on preceding days of the experiments had caused the differences in the amount of desynapsis observed on the preceding days. This is an additional evidence to indicate the effect of temperature on desynapsis.

Duration of treatment in relation to the amount of desynapsis

Since the spikes used to determine the univalent frequencies were picked at different but definite intervals, it is interesting to know whether duration of

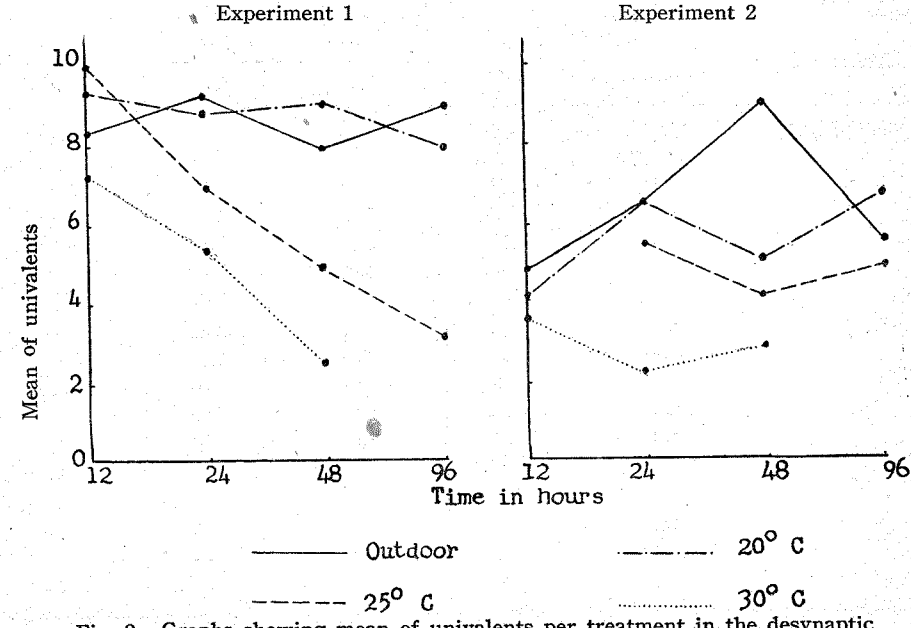

Fig. 2. Graphs showing mean of univalents per treatment in the desynaptic plants grown at different intervals of the same temperatures.

treatment will bear some relationship with the amount of desynapsis. Such results are included in Tables II and III and graphed in Fig. 2. From the tables and figure, it can be seen that for the materials taken at 20°C no significant differences in the means of univalents were found at different intervals. Thus, such distribution curves are more or less parallel to that of the controls, except at 48-hour interval in the second experiment. When the materials taken at high temperatures were checked, it was found that prolonged treatment did favor the pairing of chromosomes. This was particularly true for the materials grown at 30°C. Thus, at this temperature, the means of univalents at 12-24- and 48-hour intervals were 7.33, 5.48, and 2.54 respectively in the first experiment and 3.74, 2.28, and 2.97 in the second one.

When the plants were examined individually this timing effect was even more clear. Such data are grouped in Table V. As seen from the table, spikes picked from same plants grown at 20° C might have different means of univalents but showed no relationship with the duration. However, spikes taken at different intervals from the same plants grown at 25°C and 30°C had significantly different means of univalents, the longer the duration the less the number of univalents. These results may suggest that the effect of temperature on pairing of chromosomes may be a gradual one.

Table 5. Average number of univalents per PMC of individual desynaptic plants after 12, 24, 48, and 96 hours in the temperature-controlled rooms (Experiment 1 & 2)

Treatment	Progeny and plant No.	Duration in hours			
		12	24	48	96
20.0°±0.5°C	1-12	8.76	9.28	—	8.45
	4-12	8.00	9.76	—	7.81
	4-15	10.40	10.00	7.33	—
	5-13	9.33	7.30	10.16	—
	6-13	4.17	6.30	5.16	4.83
	1-16	—	8.00	7.30	—
	7-12	—	5.67	6.80	7.82
25.0°±0.5°C	4-21	—	7.09	4.62	—
	6-21	—	6.40	5.54	—
	6-22	—	7.74	—	3.20
	7-22	—	7.25	4.12	—
	7-23	—	7.05	4.31	4.60
30.0°±0.5°C	6-31	7.71	5.14	—	—
	6-32	—	6.00	2.10	—
	5-34	3.30	—	2.00	—
	5-35	5.14	1.68	—	—
	1-31	2.89	3.25	—	—

The differences in univalent frequencies observed between the first and the

second experiments due to the differences in temperatures on preceding days even after the plants had been grown for a period in the temperature-controlled rooms, is a further evidence for the above conclusion.

Discussion

The effect of temperature on asynapsis or desynapsis has been demonstrated in several cases. However, its mode of effect has not been clearly indicated. In a study of the tomato asynaptic mutants, Soost (1951) found that the materials collected from the same plant but at different times of the same day had different amount of asynapsis, being less in the material collected at 4 P. M. than in the material obtained at 7 A. M. The temperature at 4 P. M. was 92°F and at 7 A. M. 55°F. This might indicate that high temperature would favor pairing of chromosomes and vice versa. But Soost tended to think that if a time lag between zygotene and diakinesis were considered and assumed that it was to be 12–18 hours and that the effect of temperature was at the period of early meiotic prophase, the effect of temperature would be reversed, i. e. high temperature would induce more asynapsis and low temperature would favor pairing of the chromosomes. This is the case reported by Goodspeed and Avery (1939) in the asynaptic *Nicotiana*. In their study, Goodspeed and Avery used the maximun temperature on the day before the collection of the material was made. Soost further stated that same interpretation would be applicable to the results reported by Li *et al* (1945) in a desynaptic wheat.

In the present study on the effect of temperature in a desynaptic rice mutant, the timing of various stages of microsporogenesis was not conducted, and as far as the author is aware no such report has been available in the literatures. However, if a time lag of 10–20 hours between pachytene and MI were a plausible assumption, then the results obtained in this study would indicate that at least in this study, high temperature definitely favors the pairing of chromosomes, whereas lower temperature causes more desynapsis. This fact is even aggrandized since the desynaptic plants remained in the temperature-controlled rooms for 24 hours or more, greater amount of desynapsis was still observed in the material collected from lower temperature than from the high temperature. Moreover, progressive decreasing of the numbers of univalents due to prolonged remaining the plants at the same high temperature will point to the fact that the effect of temperature on desynapsis may be an indirect one. Its effect might impose upon stages prior to meiotic prophase.

Thus, the question of the action of the desynaptic gene on the pairing of chromosomes arises. Various theories such as chromatid breakage and reunion due to gene-controlled enzyme deficiencies, changes in physical properties in the cytoplasm or in the chromosomes, disturbances in relation between chromosome duplication and pairing, etc. have been proposed to answer the question.

Interesting results and interpretations from the biochemical studies on the action of the ameiotic gene in maize which completely inhibits meiosis in both micro and megasporocytes, have been reported by Sinha (1959). His studies indicate that there is an accumulation of precurssors of nucleic acids in the ameiotic young ears and that the amount of ribose nucleic acid (RNA) and "histones" relative to the deoxyribose nucleic acid (DNA) is greater in the ameiotic ears than in the normal ones. From these results, Sinha believes that the ameiotic gene may partially block the synthesis of DNA, which will favor the synthesis of RNA and this, in turn, will cause the formation of more proteins. Thus, a critical balance between the two nucleic acids and between DNA and "histones" seems necessary for normal meiosis.

Table 6. Amount of RNA in the normal and desynaptic florets (results express as μg/450 mgm. florets).

Sample pair No.	Normal florets	Desynaptic florets
13	21.42	32.85
15a	60.95	61.42
15b	47.14	58.57
18	54.57	58.85
19	38.57	32.00
20	37.71	50.28
28	28.57	33.14
33	28.00	30.85

Stimulated by Sinha's report, a preliminary analysis of the nucleic acid content in the young florets of the desynaptic and normal plants has been conducted. Two samples of a pair were taken from a desynaptic plant and normal plant of the same progeny at the same time and followed strictly the same procedure of nucleic acid analysis. Different sample pairs were picked on different dates and treated in a slightly modified way. The results of the RNA analysis are presented in Table VI and Fig. 3, from which it is noted that greater amount of RNA was found in the desynaptic florets than in the normal ones. This may indicate that more RNA was being synthesized in the desynaptic florets than in the normal ones. Owing to the fact that the DNA extracts were found to be contaminated with other substances, determination of the DNA will have to be repeated.

No definite conclusion can yet be made from such preliminary study and more extensive biochemical analysis of this mutant will have to be conducted. However, from the results of the study on the effect of temperature on desynapsis reported in this paper as well as in other literatures, together with the fact that

consistent higher RNA content present in the desynaptic florets than in the normal ones, we have arrived at a conclusion that this desynaptic gene might have partially blocked the synthesis of certain substance(s) necessary for maintaining the normal pairing of chromosomes until early AI should be natural, as temperature-sensitive mutants partially suppressing certain step of biochemical synthesis have been found in other organisms (see Wagner and Mitchell, 1955).

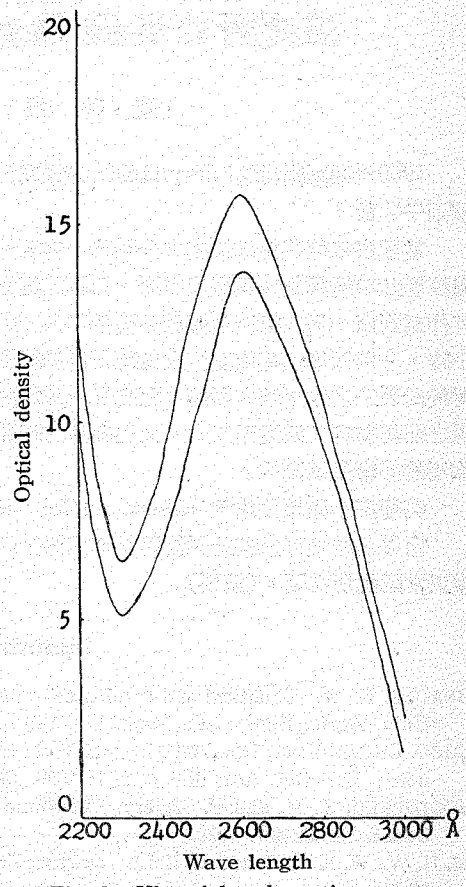

Fig. 3. Ultraviolet absorption spectra of RNA extracted from the desynaptic (D) and normal (N) florets (average of 8 samples each).

Summary

Genetic data obtained in this study for a desynaptic mutant in rice confirm that desynapsis in this mutant is due to a recessive gene. The symbol *ds* has been assigned for this gene.

From the study of the effect of temperature on the desynaptic gene under controlled condition, it was found that high temperature favored the formation of bivalents and low temperature induced more desynapsis. Since prolonged remaining the desynaptic plants at high temperature would gradually decrease the number of univalents at MI, the effect of temperature on desynapsis might be an indirect one.

The amount of RNA per unit weight was greater in the desynaptic florets than in the normal ones. From these results it is interpreted that the desynaptic gene may partially block the synthesis of certain substance(s) which is necessary for maintaining the normal pairing of chromosomes until early AI since temperature-sensitive mutants have been known in other organisms.

溫度對於水稻 Desynapsis 因子之影響

趙傳纓 胡慧琳

1960年繼續作水稻 desynapsis 突變型分離研究之結果，證明此突變型係由於一隱性突變因子之故。

當觀察每穗花粉母細胞之分裂時，發現即使同一株植物單價體之數目，隨時日而有異。爲瞭解此項變異是否與溫度有關，乃將此突變型植株分爲四組，每組約二十株，一組置於室外作爲對照，另三組則於減數分裂前移入 20°C, 25°C 與 30°C 之溫室內，經 12, 24, 48, 96 小時，分別採集幼花穗而決定每穗花粉母細胞第一中期單價體之平均數，試驗結果證明溫度對於此因子之作用確有影響，在高溫內單價體少，低溫則多。故高溫對於此突變型植株染色體之配對有利，低溫則反之。又在高溫內時間長，則單價體少。故可推定溫度對於此因子之作用的影響是逐漸的。

突變型小穗單位重量 Ribose nucleic acid 之含量比正常者爲高。

由以上結果可推測此突變因子可能部分阻塞了某種物質之合成，而此種物質爲保持染色體正常配對所必要。(摘要)

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