Some observations on heading and blooming of diploid and autotetraploid rice (Oryza Sativa L.)

Luong, Dinh, Cua
Laboratory of Genetics, Biological Institute, Kyoto University

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SOME OBSERVATIONS ON HEADING AND BLOOMING OF DIPIOID AND AUTOTETRAPLOID RICE (*ORYZA SATIVA* L.)

LUONG DINH CUA*

Accumulated data on artificial autopolyploid have shown that flowering in induced polyploid plant species is usually later than their corresponding original diploid forms. However, thorough comparative observations on this characteristic, between diploid and induced autotetraploid, were few in records. With regard to rice, a crop of great importance, such studies have not yet been reported.

In spite of the fact that autotetraploid rice is more or less useless (Morinaga and Fukushima 1937, Jones and Longley 1941, Cua 1950b) owing to the high sterility and reduced number of spikelets per ear it remains to be found out whether hybrids between autotetraploid rice of different origins, viz. *Indica* and *Japonica* types, would have any future as regards fertility and so on, such as the highly fertile intersubspecies tetraploids obtained from chromosome doubling of hybrid seeds reported by the writer elsewhere (Cua 1951 and in press). Thus, on the practical side of breeding, a knowledge of the heading and blooming habits of autotetraploid rice is quite helpful in the carrying out of artificial hybridization.

In this paper, data obtained from the comparative observations on heading of three autotetraploid rice varieties and their corresponding diploid forms, namely *Kairyo-habutae-mochi*, *Konan-to* and *Rikuu* 132, and on the time of blooming of diploid and autotetraploid *Rikuu* 132 are briefly dealt with. Both diploid and autotetraploid materials already described somewhere (Cua 1950a, b and c, 1951) were grown in the same field under normal environmental conditions. As it must be expected that aneuploids would occur in the autotetraploid populations, only normal-looking individuals were selected and used.

Heading

In this study, an individual is considered headed when the tip of anyone

* Contributions from the Laboratory of Genetics, Biological Institute, Kyoto University, no. 215

of its spikes out from the flag-leaf sheath. Under normal conditions, the time required for heading, that is the number of days from seeding to the first appearance of the panicle from the flag-leaf sheath, is a varietal characteristic which, while being quite constant within a certain variety, varies in different ones.

Artificially induced autotetraploids have been observed to begin to bloom later corresponding diploids. The same inclination was noticed in rice. However the results obtained by the writer indicated that the tardiness of autotetraploid in flowering is not universal among the 3 varieties employed. In other words, in rice, with regard to certain characteristics, the doubling of chromosome might not always implicitly produce the same effect in every variety.

Table 1. Heading in diploid and autotetraploid rice.
(Seeding date: May 23)

Varieties		Daily heading percentages															Aver. nos. of days from seeding to heading	Nos. of indiv. observed
Kairyo-habutae-mochi	2X	1.8	3.7	17.8	44.2	16.0	15.0	0.9	—	—							101.19	318
	4X	7.0	11.6	18.2	22.7	16.6	14.6	7.0	1.5	—							101.10	394
Konan-to	2X	2.8	5.7	11.4	14.2	22.8	19.9	14.2	8.5	—	—	—	—	—	—	—	98.08	245
	4X	—	—	0.4	0.4	2.8	3.7	3.2	11.3	14.1	33.9	6.1	10.3	8.9	2.3	1.8	102.90	212
Rikuu 132	2X	8.8	11.0	28.7	26.5	8.8	11.0	4.4	—	—	—	—	—	—	—		87.66	405
	4X	0.9	2.9	5.8	10.6	2.9	8.7	20.3	6.7	10.6	7.7	10.6	7.7	3.8	—		91.15	412

As shown in Table 1, the average time from seeding to heading was longer in autotetraploid *Rikuu* 132 and *Konan-to* than their respective diploid forms, by a difference of about 3 and 4 days respectively, that observed in *Kairyo-habutae-mochi* was somewhat shorter.

The date of the first panicle emergence from the flag-leaf sheath was the same in both diploid and autotetraploid *Kairyo-habutae-mochi* and *Rikuu* 132. In *Konan-to*, diploid started 2 days before the autotetraploids, in heading.

In general, as indicated by Figure 1 (A, B, C,) representing the daily heading percentages of diploid and autotetraploid varieties, the heading period of autotetraploid rice was much longer and in some degree less uniform than that of the diploid. Autotetraploids *Kairyo-habutae-mochi*, *Konan-to* and *Rikuu* 132 required 8, 13 and 13 days respectively for their heading period as

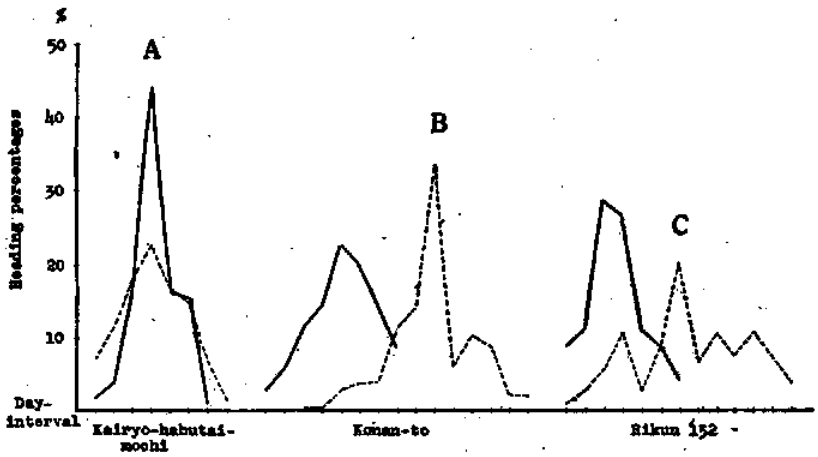

Fig 1. A, B, C, Daily heading percentages of diploid and autotetraploid rice (smooth lines, diploid; dotted lines, autotetraploid).

against 7, 8 and 7 days in their corresponding diploids.

Blooming

In rice, blooming consists of the opening of the outer and inner glumes preceded by the swelling of the lodicules and followed by the elongation of the anther-bearing filaments and the dehiscence of the anthers. A morphologically and physiologically mature spikelet is ready to bloom under the optimum external conditions. However, numerous factors governing the environmental conditions, such as temperature, humidity, light, etc., play an important part in the blooming of rice flowers.

Observations on the time of blooming of diploid rice have been made by many investigators (Iso 1913, Hector 1913, etc.). The results reported show that, though time of the day at which blooming begin differed, — depending upon what period of the year the investigations had been carried out —, the higher the temperature, the faster and earlier it begins and vice versa.

As early as 1913, Iso observed that blooming started at 9 am. reached its maximum at 11 am. and continued till 2 pm. on June. Jones (1924), with observasions conducted at a later period of the year, reported that maximum blooming had been observed to take place from noon to about 2 pm. Hector (1913) pointed out that while on May-June blooming started from 7-8 am. it was retarded by two hours on October-November.

As a rule, maximum blooming coincides with the maximum temperature of the day, then gradually decreases as the temperature falls.

Investigations conducted in this study were started on August 22 and continued hourly from 7 am. to 5 pm. for 5 consecutive days using diploid and autotetraploid *Rikuu* 132.

Table 2. Average temperature and blooming percentages of diploid and autotetraploid *Rikuu* 132.

Time		7 am	8 am	9 am	10 am	11 am	12 am	1 pm	2 pm	3 pm	4 pm	5 pm	Nos. of florets observed
Temperature (C.) 5-day average		25.5	27.9	29.8	31.7	33.5	34.7	33.5	33.1	32.0	31.6	30.1	
5-day average percentage of florets bloomed	*2X*	—	0.04	0.09	0.39	26.26	62.96	7.64	0.88	0.14	0.09	—	2011
	4X	—	—	—	0.12	92.41	64.38	23.80	1.28	0.64	0.38	—	780

Shown in Table 2 are the aaerage blooming percentages of diploid and tetraploids and the average temperatures observed during the 5 day period.

In diploid, the first flowers were observed to bloom. at 7-8 am. and the last ones, at 3-4 pm.; the maximum blooming period being at 11-12 am., where the temperature of the day was observed to be at its highest.

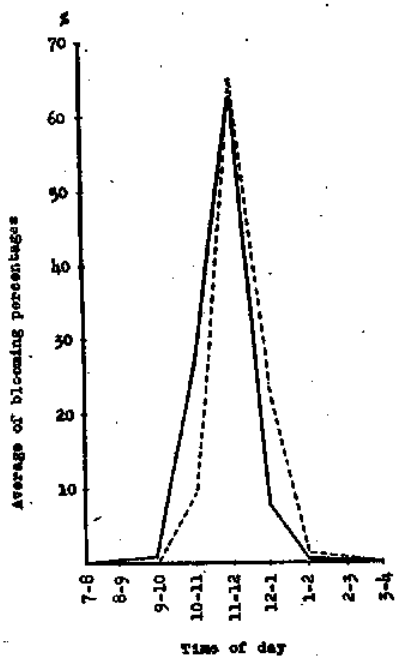

Fig 2. Average blooming percentages in diploid and autotetraploid *Rikuu* 132 (smooth lines, diploid; dotted lines, autotetraploid).

The same inclination was also present in the autotetraploid, with the exception that blooming started about two hours later than the diploid. It nevertheless ceased nearly at the same time.

Graphs represented in Figure 2 show that the maximum percentage of both diploid and autotetraploid *Rikuu* 132 took place at the same time, that is at 11-12 am. On the other hand, though blooming began later in autotetraploid, its blooming percentages, after the maximunm blooming was reached, were higher, — approximately 26.1% as against 8.7% —, than those of its corresponding diploid.

Summary

Observations on heading of diploid and autotetraploid rice revealed that though the heading period of autotetraploid rice was longer and less regular than their corresponding diploid forms, the date of the first panicle emergence was the same in some varieties.

In *Rikuu* 132, blooming of autotetraploid started 2 hours later than the diploid reached its maximum and ceased nearly at the same time with the diploid.

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