

## STERILITY OF INTER-RACIAL AND INTRA-RACIAL F<sub>2</sub> HYBRIDS OF RICE\*

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Working with more than 200 varieties, Kato *et al* (1928) proposed to classify *O. sativa* into the two races, *japonica* and *indica*, based on morphological differences and sexual affinity. The existence of hybrid sterility of 66 to 100 per cent between the two groups in contrast to 16 to 51 per cent within *japonicas* and 29 to 31 per cent within *indicas* aroused much interest among rice workers. Hsu (1945) found that the inter-racial hybrid sterility was genic in nature while Sampath and Mohanty (1954) observed that partial sterility encountered in some hybrids was due to cryptic structural differentiation in the chromosomes arising from included inversions. In a backcross experiment between a Phillipine variety and a Japanese variety, Kitamura (1962) reported occurrence of cytoplasmic sterility in rice. Oka (1956) reported instances of sterility in intra-racial hybrids also. In the present investigations sterility of inter-varietal crosses of rice representing *japonica* and *indica* was studied.

### Material and Methods

The inter-varietal crosses (female male) studied were:

1. Vellayani 1 X Tainan 3 (*indica* X *japonica*)
2. Tainan 3 x Vellayani 1 (*japonica* X *indica*)
3. Vellayani 1 X Taichung Native 1 (*indica* X *indica*)
4. Taichung Native 1 X Vellayani 1 (*indica* X *indica*)

All the available seedlings of the four crosses were planted separately in singles in the main field, 25 days after sowing at a spacing of 30 cm either way, in such a way that seeds obtained from one F<sub>1</sub> plant represented one F<sub>2</sub> family. Hundred plants in each of the three parents were also raised side by side with the hybrids for comparison.

To ascertain the degree of sterility of pollen grains, fresh pollen grains were collected at the time of anthesis and their sterility determined by the acetocarmine staining method of Zirkle (1937). Counts were made from 30 microscopic fields selected at random for each plant and percentage of pollen sterility calculated.

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Hsu (1945) reported that spikelet sterility often exceeded pollen sterility. The results of the present studies did not agree with this. In three out of four crosses studied, the mean spikelet sterility was lesser than the corresponding pollen sterility. Further, there was no definite relation between pollen sterility and spikelet sterility in *indica* x *indica* hybrids unlike the *indica* X *japonica* hybrids. This was contrary to the findings of Joseph (1962) who reported lesser spikelet sterility than pollen sterility in *indica* x *indica* crosses which may be attributed to differences in climatic factors (Hoshika 1941 and Webster 1950).

All the plants examined showed a somatic chromosome number of 24. In pachytene, a few instances of formation of chromosome loops characteristic of inversion were seen in both the crosses of Vell. 1 x Tain. 3 and Tain. 3 X Vell. 1 indicating structural differences of chromosomes of *indica* and *japonica* types. Metaphase and anaphase were observed to be regular in all the crosses studied. Regular pairing chromosomes at metaphase I of meiosis to form 12 bivalents was observed, though the hybrids were partly sterile.

### Summary

Pollen sterility and spikelet sterility were more in inter-racial hybrids than in the intra-racial hybrids. In both the racial groups, hybrids exhibited the minimum percentage of pollen sterility when Vellayani 1 was used as the male parent.

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To assess the extent of spikelet sterility, earheads from the main tiller were collected from each of the plants and the total number of well filled grains and chaff counted separately and the percentage of chaffy grains calculated.

For cytological studies, panicles of proper stage were fixed in 1:3 acetic alcohol for overnight and stored in 70 per cent alcohol. Temporary slides were prepared with one percent acetocarmine.

### Results and Discussion

Data on pollen and spikelet sterility are presented in Table 1. The mean range of pollen sterility observed in the hybrids of the four cross combinations ranged from 22.1 to 45.2 per cent as against a range of 9.5 to 14.0 per cent in the parental varieties. Further, pollen sterility was more in the cross Vell. 1 X Tain. 3 and its reciprocal (45.2 and 38.0 per cent) than in the other cross combinations (31.1 and 22.1 per cent) The lesser percentage of pollen sterility observed when Vsllayni 1 was used as male parent was probably due to the comparatively lesser percentage of pollen sterility in the indica parent itself or due to the effect of certain cytoplasmic factors. No detectable ratio for pollen stainability, could be noted in the F<sub>2</sub>.

**Table 1**  
**Percentage of pollen and spikelet sterility in different strains of rice and their crosses**

Strain or cross	Pollen sterility	Spikelet sterility
Vellayani 1	11.0	11.0
Tainan 3	14.0	15.0
Taichung Native 1	9.5	17.8
Vell. 1 x Tain. 3	45.2	31.8
Tain. 3 X Vell. 1	38.0	33.3
Vell. 1 x T. N. 1	31.1	29.4
T. N. 1 x Vell. 1	22.1	29.0

The two crosses of Vell. 1 X Tain. 3 and its reciprocal showed 31.8 and 33.3 per cent spikelet sterility respectively as against 11.0 and 15.0 per cent recorded by their respective parents Vellayani 1 and Tainan 3. The cross Vell. 1 X T. N. 1 and its reciprocal recorded 29.4 and 29.0 per cent spikelet sterility as against 11.0 and 17.8 per cent respectively for the two parents.