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Studies on anthesis, pollination and hybridization techniques in Rice (*Oryza sativa* L)*

by

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Introduction: For scientific crop breeding approach, a precise knowledge of anthesis and pollination is the prerequisite. Since anthesis and pollination vary greatly according to the environment in which the crop is grown, a detailed study of these two aspects has to be made at the locality where the hybridization programme is carried out. Closely with the study of anthesis and pollination, various artificial hybridization techniques under the same environment have to be experimented with a view to fix up the best. Under Coimbatore conditions, since a comparative study of different hybridiation techniques and the nature of anthesis in rice was not made before, this item of work was undertaken at the Paddy Breeding Station, Coimbatore between 1959 and 1961.

Material and Methods: Three departmental strains of Madras State viz., PTB. 10 *(Thekkan cheera)*, Co. 13 *(Arupatham kodai)* and TKM. 6 *(Sanna swarnawari)* of *Oryza sativa* (L) and an exotic type T. 868 from Gold Coast, of *Oryza glaberrima* (Steud) were taken up for study. The duration of these varieties from seed to seed ranged from 100 to 135 days.

The sprouted seeds of the four varieties were sown in wet nurseries and the seedlings were transplanted on 25th day of sowing in singles with the spacings of two feet between rows and one foot between plants for experiments on hybridization techniques and one foot between rows and six inches between plants for experiments on anthesis.

For the study of anthesis, the main tiller from each clump was marked and labelled and ten such main tillers were taken up to compute - (i) time taken for the completion of emergence of the panicle, (ii) time taken between time of emergence and commencement of blooming (iii) rate of anthesis and period required for completion of anthesis in a panicle and (iv) blooming period of spikelets in a panicle. Two strains viz., PTB. 10

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and Co. 13 and type T. 868 were utilized for the study. To devise a suitable emasculation technique, five different methods viz., hot water method, clipping method, bagging method, splitting method and wet cloth method were tried using Co. 13 and TKM. 6 strains and the results were interpreted. The emasculation was done two hours prior to the normal time of anthesis and the panicle was protected by means of staked muslin bag.

Under *hot water method,* the general technique as described by Gangulee (1956) was followed. The panicles were treated at different temperatures viz., 40°C, 42°C, 44°C and 46C with an interval of 2, 4, 6, 8 and 10 minutes. *Clipping method* as described by Jodon (1938) was adopted. The top one third portion of the glumes was scissored off and the protruding anthers were removed by means of a fine pointed forceps. Aa described by Ramiah (1927), for *bagging method,* brown paper covers of size 9″×3″ were used for covering the chosen panicles. As the spikelets open, the protruding anthers were removed by means of a pair of forceps. In the *splitting method,* a pair of forceps was used to split open the glumes to an angle of about 30° and the emasculation was done by removing the anthers.

In addition to the above mentioned four methods of emasculation, a new method termed as *Wet cloth method* being adopted at the Paddy Breeding Station, Coimbatore was also tried. For this, a suitable panicle that has started blooming one or two days earlier is selected and pollinated flowers at the top are clipped off. A clean white cloth preferably Khadi cloth dipped in warn water is taken with a little moisture and the selected panicle is jacketed gently and the hot air is blown from the mouth sufficiently to warm the cloth. In about 10 minutes, all the spikelets that are to open on that day will be forced to open and with the aid of a pair of forceps the unburst anthers can easily be removed. After emasculation all the unopened spikelets are removed and the panicle is protected.

The pollen required for pollination is collected just half an hour prior to the normal dehiscence. The selected panicles in sufficient numbers are removed with stems 30 to 45 cm. in length and wrapped in a wet cloth. By keeping the panicles under direct sunlight, the spikelets are induced to open at a time when the anthers are getting ready to burst. As the anthers come out, they are removed one by one with a fine pointed forceps and rubbed gently over the stigmatic lobes with care not to injure them. In this operation the anther bursts shedding the pollens over the stigma. Thus pollination is ensured and the panicles are labelled with the details of the parents, number of spikelets pollinated with date of pollination and covered with staked cloth bags. On the 30th day, the ripe seeds are collected, sundried and preserved in bottles.

Experimental results: (i) *Period of emergence of the panicle:* The period of emergence of the primary panicle of the three rice varieties varied considerably indicating that it was a varietal character correlated with total duration of the variety. PTB. 10 and CO.13 took on an average 3·5 and 3·2 days respectively to complete the emergence of the primary panicle while for T. 868 it was 5.4 days.

(ii) *Sequence of panicle emergence and anthesis:* The number of days taken from the date of emergence to the blooming of the first spikelet in a panicle was calculated and taken as the time required between initial emergence of the panicle and starting of anthesis. On an average anthesis of the first spikelet was noticed on the 1.9th day in PTB. 10 on the 1.7th day in CO. 13 and on the 1.4th day in T. 868. This clearly indicated that emergence and beginning of anthesis were continuous processes without any demarcation.

(iii) *Rate and nature of anthesis:* The first date of anthesis was noted with the number of spikelets opened on that day. Daily recording was done until all the spikelets in a particular panicle complected the phase of anthesis. The rate of anthesis and the total number of days taken by each panicle for completion of blooming was computed. The rate of opening of spikelets was more or less similar in the two varieties, PTB. 10 and CO.13 reaching the peak on the second or third day while in T. 868 it was of a unimodal pattern. On the fourth day, a sharp fall was noticed in respect of PTB. 10 and CO. 13 whereas it was not in the case of T. 868. It was noticed that by seventh day blooming ceased in the *sativa* group while it extended by one more day in the case of *glaberrima* type. This clearly indicated the differential behaviour of the types belonging to two different species grown under the same environment.

(iv) *Blooming period of the spikelets:* The blooming period for selected spikelets in a panicle was recorded to elucidate the time of dehiscence and period of blooming of a variety. Of the three varieties studied, on an average, PTB. 10 commenced blooming at 10·41 A. M. and the spikelets remained open till 11.57 A. M. taking a spell of 75.7 minutes. Likewise, strain CO. 13 commenced blooming at 10.12 A. M. and the spikelets remained open till 11.03 A. M. with a spell of 50.5 minutes. The blooming started earlier at 8.58 A. M. in T. 868 and the spikelets remained open till 10.26 A. M. with the maximum spell of 87.3 minutes. Thus a distinct varietal difference existed for the time of commencement of blooming and the time taken by the spikelets to remain open.

(v) *Evaluation of the merits of the different emasculation methods:* In the study, strain TKM. 6 that lacks pigmentation was used as pistil

parent while CO. 13 with purple coleoptile was used as pollen parent. Under the splitting, bagging, clipping and wet cloth methods, ten panicles for each method were used for emasculation and pollination trials. The number of spikelets pollinated in each panicle, number of seeds set, number germinated and number of hybrid seedlings obtained were recorded. In the case of hot water method, since the number of combinations between temperature and duration of the treatments was large, only five panicles were selected for each combination treatment.

Among the different temperature treatments tried under hot water method, treating the spikelets for 8 to 10 minutes at temperature ranging from 40°C to 44°C appeared to kill the pollen completely leaving the stigma to remain receptive. The percentage of seed set, percentage of hybrids and self pollinated seedlings under the five different methods are given in table below :

TABLE

Particulars of Treatment	Percentage of seed set	Percentage of hybrid seeds obtained	Percentage of self pollination
Hot water method	38·98	100·00	Nil
Clipping method	23·36	83·33	16·67
Bagging method	59·26	75·00	25·00
Splitting method	42·86	83·87	16·13
Wet cloth method	77·94	93·27	6·73

Discussion : Balaji Rao (1926), Parthasarathi (1927) and Kadam and Patel (1933) reported that blooming of spikelets was at its peak on the second or third day of anthesis and it was completed within a week. This finding was in conformity with that obtained in PTB. 10 and CO. 13 of *sativa* group while the anthesis was slighty prolonged in respect of *glaberrima* type which was another species grown under the same environment. There was a perceptible difference among the three varieties in the commencement of blooming as well as the length of blooming period of individual characteristics. Ramiah (1927), Bhide and Bhalerao (1927) have observed different timings for different vorieties and they concluded that besids the varietal charactors, prevailing weather elements such as temperature and relative humidity might also govern the process of anthesis. Under hot water method of emasculation, Joden (1934), Gangulee (1936) and Brown (1955) observed the temperature of 45°C to be lethal for both pollen and the stigma. Ramiah (1927) who introduced bagging method, reported good

results, but contradictory findings were recorded by different workers like Butany and Shastry (1955) and Butany and Gangadharan (1960). Under the conditions existing at Coimbatore, a maximum of 25 per cent of self pollination was recorded. The splitting method is also widely used as indicated by Ramiah (1927), Butany and Shastry (1955) and Gangulee (1956). This method recorded 83.87 per cent of hybrid seeds under Coimbatore conditions.

The wet cloth method followed at Paddy Breeding Station comprises two main aspects found in bagging method and hot water methods. It provides required humidity and temperature and allows easy and quick emasculation of spikelets. Further the initial cost and labour requirements are low in this method. This method has also given the maximum percentage of hybrid seeds with self pollination to the minimum. Therefore this method may be admirably suited for large scale production of hybrid seeds.

Summary: In an experiment on anthesis and different methods of emasculation, three short term rices viz. PTB. 10, CO. 13 and TKM. 6 of *Oryza sativa* (L) and a type T. 868 of *Oryza glaberrima* (Steud) were studied. The varieties of *O. sativa* took on average 3.3 days for complete emergence of panicle while for *O. glaberrima*, it was 5.4 days. The blooming occurring on second and third day after the commencement of anthesis in *sativa* group whereas in *glaberrima* type it extended upto 4th day. In *O. glabeerima* the natural blooming started at 9.00 A. M. and in *sativa* it started at 10 A. M. The spikelets remained open for 50, 76 and 87 minutes respectively in varieties CO. 13, PTB. 10 and T. 868. The comparative study with different methods of emasculation viz., hot water. clipping, splitting, bagging and wet cloth, indicated the hot water method and wet cloth method to be promising. Where large scale production of hybrid seeds are desired, wet cloth method will be efficacious; for genetical studies adoption of hot water method is ideal.

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