

TRADITIONAL RICE CULTIVATION PRACTICES

Should there be a Reappraisal ?

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AFRICA is traditionally the dark continent but may it not perhaps put forth some light? Has not the evolution of rice cultivation there followed similar lines to that of rice cultivation in the East thousands of years earlier? In Africa the wild species *Oryza breviligulata* and *O. stapfi* are plants of wet places. The distinction between the two species is not clear cut and the ecological and morphological differences which are apparent may be the extremes of a range of types. From this wild population we believe that the cultivated *O. glaberrima* has arisen—in fact the distinction between some forms of *O. glaberrima* and *O. stapfi* is not altogether clear. *O. glaberrima* in cultivation occurs in two main forms—that of a deep-water floating rice and that of an upland rice. The floating types are confined to comparatively few places while the upland types extend over a wide area. There do not appear to be any types of *O. glaberrima* which are normal swamp rices. The first question we should ask is therefore :

May not the cultivation in the East of *O. sativa* have arisen as upland cultivation from the original wild wetland species ?

At this stage in Africa *O. sativa* was introduced as an upland rice and the story as it progresses is with this species. As pressure on the upland increased, rice cultivation extended on to land which seasonally became wet and it was found that some plants withstood these wetter conditions. With further pressure on the land, cultivation was carried out in valley bottoms on true wetland. The old practice of direct broadcasting of seed was at first used but it was found difficult to cover the seed in the wetter soil and other methods had to be evolved. It is not clear whether broadcasting of pregerminated seed on the surface of the wet soil became general, to be replaced later by transplanting, or whether both methods developed side by side. In any case, transplanting soon became the usual method and the sowing of pregerminated seed now only lingers in a few places. Transplanting was evolved because of the damage to directly sown seed

by water movement—in fact the first transplanting carried out was with seedlings which had been washed out of a farm by heavy flood, were found caught up on the root of a tree, and were pushed back into place by the farmer. The soil in these wetlands being permanently soft, this method spread swiftly over the whole area—the seedlings being safely raised on the uplands away from the floods. The second question is therefore: Did not possibly a similar sequence of causes and events obtain in Asia in the dim and distant past ?

Here we must leave Africa, as at the present time no further steps have been taken, but we can examine in Asia what we know to have happened and conjecture the probable course that rice cultivation may have followed.

Over the centuries pressures on the land increased, and with the rise of ancient civilizations attention was turned to increasing the areas on which swamp rice—now the main form of rice and the staple food of the people—could be grown. Elaborate irrigation works were carried out and land which was formerly too dry to mature a crop became available. Is it not probable that the transplanting method, having by now become so traditional, was carried to this new land although the need for it on account of water movement had vanished? And that the land being firm it was necessary to evolve the new technique of puddling in order to prepare it for transplanting ?

On this irrigated upland weeds were more of a problem than in the natural valley bottoms and swamps, but it was found that if the water used to irrigate and soften the land was held on the land with the growing crop the weed problem was much reduced. And that the pre-flooding itself caused weed seeds to germinate and they could be removed before the rice was planted. Is not this the reason why transplanting as a method persisted, and the holding of water on the rice land became a general practice? Is not rice in fact a crop that will tolerate standing water rather than one which needs it? And have comparisons of yield between transplanting and direct seeding made in

the past been strictly valid, i.e., may not differences found have been due to other factors such as greater uniformity of spacing?

Having asked ourselves these questions, it becomes logical to ask two more. Now that effective weedicides appear to be bringing the weed problem under control, is it still necessary to hold standing water on rice land to its present extent, and are in fact transplanting and puddling still essential? There will of course be many conditions where they are for various reasons, but are they essential in all conditions where they are now used? Finally, to generalize: Were not the traditional cultural practices closely linked into a uniform

method, and should not changes that have been made in some of these practices be followed by a general reappraisal of the others now that the balance of the method has been upset?

I do not pretend to know the answers to these questions but have long wondered if we should not try to answer them. And I know that some at least are in the minds of other rice workers. Certainly recent work with varieties of high fertilizer response has shown that we must re-examine all we know about fertilizer application and plant density. I think the time has come when we should all make a critical reappraisal of the whole range of traditional cultural practices.

EMBRYOLOGY AND SYSTEMATIC POSITION OF *PENTAPHRAGMA HORSFIELDII* (MIQ.) AIRY SHAW

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THE genus *Pentaphragma* came into prominence recently when Airy Shaw^{1,2} sought to remove it from the Campanulaceæ and raised it to the status of a new family Pentaphragmataceæ. According to him its habit and foliage suggest certain Begoniaceæ, Rubiaceæ (*Argostemma*), and Gesneriaceæ (*Epithema*); the succulence of the stem and leaves recalls the Cucurbitaceæ; the scorpioidally cymose inflorescence is similar to that of some Hydrophyllaceæ and Boraginaceæ; and the indumentum of branched, multicellular hairs resembles the Solanaceæ. He remarked: "Almost every author who has dealt with *Pentaphragma* has admitted its highly anomalous position in the Campanulaceæ, and it is therefore surprising that it has not been removed earlier."

Bentham and Hooker,³ and Engler and Prantl⁴ included *Pentaphragma* in the Campanulaceæ. Hallier (quoted in Airy Shaw¹) retained this genus in the Campanulaceæ, but admitted that it showed certain resemblances in its inflorescence with the Boraginaceæ, Convolvulaceæ (*Jacquemontia*) and Loasaceæ (*Kissenia*). According to Metcalfe (cited in Airy Shaw¹) there is nothing about its anatomy "which is inconsistent with the suggestion that the plant may belong to the Begoniaceæ". However, Metcalfe and Chalk⁵ have themselves included it as an anomalous genus in the

Campanulaceæ. In view of the divergent opinions of taxonomists, it was considered worthwhile to investigate the embryology of *P. horsfieldii*, material of which was very kindly supplied to us by Mr. K. Jong and Dr. A. N. Rao of the Universities of Malaya and Singapore.

The inflorescence is a scorpioid cyme with numerous flowers arranged in acropetal succession (Fig. A). The flowers (Fig. B) are small, sessile, bisexual and actinomorphic (excepting the calyx). The ovary is bicarpellary, bilocular and inferior, and contains numerous anatropous ovules arranged on axile placenta. The wall of the anther is made up of five layers—the epidermis, the fibrous endothecium, two middle layers and the tapetum whose cells become binucleate. The pollen grains are tri-colporate (Fig. C) with a thick exine.

The ovule is unitegminal and tenuinucellar. A single hypodermal archesporial initial differentiates and directly functions as the megaspore mother cell (Fig. D). It is surrounded by the evanescent nucellar epidermis. A linear tetrad is formed (Fig. E) and the chalazal megaspore functions to give rise to an eight-nucleate gametophyte of the Polygonum type. The micropylar portion of the embryo sac (Fig. F) invariably comes out of the integument at the four-nucleate stage. The antipodal cells degenerate after fertilization but