that testing with litmus paper is a simple and good guide to the addition of the required quantity of lime.

The firing of the pan must be well regulated. There is always a tendency on the part of the firemen to stuff the furnace with fuel, to avoid the tediousness of slow firing, and the jaggery gets therefore charred owing to overheating. A properly constructed multiple furnace as aforementioned will avoid such a mishap.

Need for a Sugar Factory.—I was discussing the question of establishing a sugar factory with the local merchants and the ryots. The co-operation of the merchants is a necessity, and also of the ryots. If one can show some real improvement in the productivity of the land and enable the royts to get a better quality of jaggery fetching a better price, something would have been done to secure their confidence, and, when once that is established, a sugar factory will be a comparatively easy affair.

The merchants even now recognize the need for a sugar factory, but just now, owing to the prevailing financial stringency, it is rather hard for them to find all the capital needed. But there is no reason why the required capital should not be found, at least in part, from outside the cane area.

[In this connection a paper on 'Jaggery-making in Hospet and Suggestions for its Improvement' by Mr. T. Lakshmana Rao, published in vol. xvi, No. 10, October, 1928, of the *Madras Agricultural Journal* will be read with interest.—Ed., *M.A.J.*]

https://doi.org/10.29321/MAJ.10.A05016

A NOTE ON *ORYZA SATIVA* VAR. (*PLENA*) PRAIN*

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Introduction.—This Bengal variety of paddy, popularly known as 'Double rice' or double grain paddy was obtained from Poona Agricultural College in the year 1920. It is similar in most of the morphological characters to the cultivated types, but differs essentially from them in having more than one pistil in each spikelet—the unit of inflorescence. In this 'Double rice' 6.3,4 the number of pistils varies ordinarily from two to four, and rarely five are met with. The number of developed rice-kernels found in each paddy grain varies from one to three so that the popular name 'Double rice' is a misnomer. The failure of some of the pistils to develop into kernels may probably be due to the infertility of those ovules, and this remains to be investigated.

2. **Rices.**—Rice kernel is enclosed within the covering of the third or flowering glume and the fourth or palea, the first two being small and sterile. The position of the embryo in the rice is opposite the base of the ridge of the flowering glume. In the 'Double rice'—calling the rice developed from the pistil nearest the flowering glume the 'first rice' and the next 'Intermediate' and the last the 'second rice'—it is observed on husking the samples of this paddy that (1) most of the single or whole

* Paper read before the Association of Economic Biologists, Coimbatore, on the 13th March, 1931.

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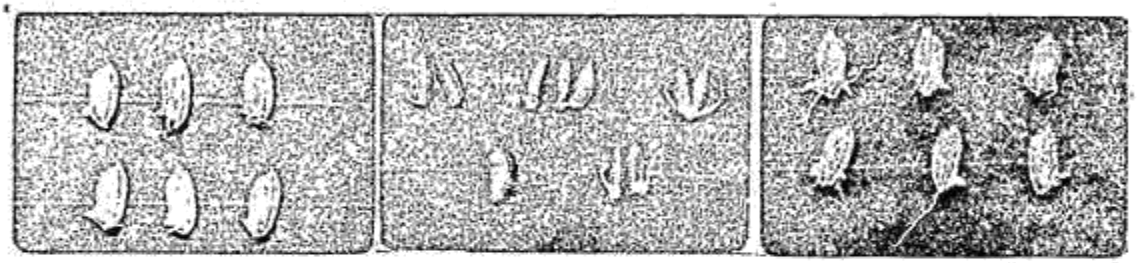

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rices developed are from the pistil nearest the third glume, (2) that in cases where there are two and three rices in each paddy-grain, the embryo of the first rice is always situated at the base of the kernel opposite the basal ridge of the flowering glume as in other cultivated rice, but the embryos of the other two, though they are situated at the base, have no definite position with regard to the flowering glume.

On husking and sorting out the rices of this paddy from samples, it is found that the proportion of the number of paddy-grains have the following frequencies.

	Percentage.
1. Single or whole rices (*a*) first pistil	42·4 ± 1·2
(*b*) From others	4·0 ± 0·6
2. Double rices	48·2 ± 1·4
3. Triple rices	5·4 ± 0·6

The development of the rices is indicated by their respective weights.

	Weight in m. grams.
1. Single or whole rice	21·6 ± 0·11
2. Double rices (*a*) First rice	12·3 ± 0·08
(*b*) Second rice	10·6 ± 0·09
3. Intermediate rice	7·8 ± 0·12

In number 2, the difference in weight between the two rices is significant and may perhaps be due to their differential positions with reference to the axis.

3. **Germination of Paddy Grains.**—It will be expected that on germinating the paddy grain, there will be as many sets of plumules and radicles as there are number of rice-kernels in each paddy-grain. But actually, only one set emerges from the base alongside the ridge of the flowering glume as in other types. (Figure 1). On carefully removing the glumes of each paddy-grain and germinating the rices, it is found that all the rices in each paddy-grain are viable. (Figure 2). This fact suggested the possibility that the fourth glume or palea has no weak spot in the corresponding place as in the third glume, to enable the rice adjacent to send out its radicle and plumule. The next step was to artificially make a slit to a small length at the base of the keel of the fourth glume, and test for germination. Figure 3 shows the result of such slitting. There are two sets wherever there are more than one rice in each paddy-grain. The intermediate rice has little chance of germination if its embryo is hemmed in between the two rices.

A preliminary study of the seedlings raised from individual rice-kernels as sorted out according to their position and number, indicated that there was difference in the rate of growth in the first fortnight. The height of the seedlings raised from single or whole rice, exceeded the others but subsequently all of them attained uniformity of growth, indicating that the difference in endosperm material had no appreciable effect on later stages of growth. (Table 1).

TABLE No. 1

Growth of the plants from different rices —Heights in c.m.

Date	Single rice	1st rice	2nd rice	Intermediate rice
June 16 ...	...	... Sown	...	...
,, 18 ...	Germinated	*Nil*	*Nil*	*Nil*
,, 19 ...	...	Germinated	Germinated	Germinated
,, 20 ...	1·6	0·7	0·7	0·8
,, 22 ...	4·6	3·1	2·5	3·6
,, 24 ...	6·4	5·5	5·3	5·6
,, 26 ...	9·6	7·6	7·9	7·3
,, 28 ...	11·4	10·3	11·2	11·4
,, 30 ...	15·3	13·0	14·0	14·0
Final Height ...	100·0	100·0	98·0	100·0
Flowering ...	All from 5th to 7th October.			

4. **Inheritance.**—Four natural crosses were spotted out in this type in the year 1926 at the Agricultural Research Station, Adutural, and these crosses had only a single pistil, indicating the dominance of the single over-multiple pistils, and the F2 progenies of the above confirmed the simple recessive nature of the multipistillate condition in rice.

*Family No.	Number of plants with single pistillate spikelets.	Number of plants with multipistillate spikelets.
2697 N	204	77
2698 N	85	37
2699 N	141	40
2700 N	156	42
Total ...	586	196
Cal, 3 : 1 ratio ...	*586·5*	*195·5*

5. **Probable Evolution.**—R. K. Bhide mentions some abnormalities he observed in this type as regards the increase in the number of stamens to more than six, the normal number, to seven and even eight and also of the increase of the number of flowering glumes.

In addition, he has noted some abnormal variations in local paddies which he classifies as—

(*a*) Variation in the size of the sterile glumes reaching up to the length of the flowering glume.

(*b*) Production of additional sterile glume by the side of normal ones.

*Annual Station Report of the Agricultural Research Station, Adutural, 1927-28.

(*c*) Production of additional flowering glumes by the side of normal ones, the extra one being more or less developed.

(*d*) Increase in the number of stamens.

(*e*) Number of pistils occasionally double.

Of the above, *a*, *b*, *c*, and *e*, have been observed in two of the types grown at Coimbatore, T. 2 and T. 443, and in addition triple ovaries in single spikelet have also been occasionally noticed, as in Sorghum 2. There was also observed, reduction or suppression of floral bracts or glumes, and also a tendency for aggregation of individual spikelets (Figure No. 4).

Bhide[1] regards the doubling of the ovaries may be due to 'temporary season' or 'the beginnings of progressive changes'. Progress in evolution is indicated according to Small [8] and Worsdell [10] by the simplification, reduction or saving of material in floral structures to the advantage of the plant. Small [8] in his article on the origin and development of *Compositæ* suggests that the evolution of *Senecio*, a species of the primitive genus in *Compositæ*, from *Lobelioideæ* was on the lines of reduction of flower material by the complete disappearance of the pedicels and the close aggregation of flowers to form the head. In the case of *Oryza sativa*, it is noted that the wild types have the spikelets arranged sparsely in the panicle, and the cultivated varieties show a marked range of variation in the arrangement of grains from this sparseness to a closer aggregation as typified in a bunched variety called *Jeeraga samba*. Another type of variation is shown in 'Cluster paddy' where a systematic grouping of 3 to 4 spikelets at regular distances occurs in the panicle. It is suggested that 'Double rice' may be a still further advance in that, in a panicle, the aggregation has taken place with the loss or complete suppression of the intervening glumes, thus increasing the number of pistils without at the same time increasing the number of stamens to more than six. Rice is essentially a self-fertilized crop [5], the extent of cross polination being 1 to 3 per cent. The pollen production in all the six anthers in each flower is certainly enormous and superfluous, allowing for all chances (the number of pollen grains being about 600 to 1000 in each anther), and in the 'Double rice' the same amount is utilized for more than one pistil. This certainly is a safe reduction of vital material in the line of progress. In this connection, it must be pointed out that there must be some significance in the facts that all these types, bunched, cluster, cigar,[5] (another type of all-round reduction) and 'Double rice' are all simple recessives to normal types. Progress in evolution takes place according to DeVries by mutations, and we can regard all these above types as mutants from the normal, and the observations recorded can be regarded as showing a tendency towards progress. These mutations should have occurred by the powerful interaction of climate and environment, resulting in the destruction of the dominant gene or loss of a factor (Bateson). Stadlers [9] X-ray effects on maize have produced mutants which are recessives, and the outward effects and genetic behaviour of these mutations are, he affirms, identical with the normal recessive genes, and this conception may equally well be applied to normal recessive mutations occurring in nature. From a scientific point of view, the line of evolution of 'Double rice' is only a suggestion, and more than that, one can repeat only the dictum of DeVries as quoted by Horne and Small [8] 'that the great lines of evolution of whole families and even genera obviously lie outside the limits of experimental observation.'

6. **Conclusion.**—It may be asked now that if double-riced paddy does represent 'advance', why has it not assumed the importance which it should deserve. The reason is obvious. This progress has been hindered by the successive suppression of the germination of all the rices other than that formed by the ovary adjoining the flowering glume, and this is quite different from that of Sorghum [7] where there is no such hindrance. This certainly is unfortunate to the plant as all the increased seed, produced by doubling and trebling, have no chances of survival, and the present condition indicates a changing back or retrogressive evolution towards the normal type, by the following observations.

1. Number of pistils in each spikelet and corresponding rices is less, 2. Proportion of single, double, and three rices. 3. Corresponding weights of these rices. 4. The very low percentage of single rices formed of other pistils than the first. This variety is certainly a very interesting material to test the effect of successive suppression of the legitimate function in the course of evolution.

Acknowledgments.—The writer is indebted to Messrs. K. Ramiah, Paddy Specialist, and M. Anandan, Superintendent, Agricultural Research Station, Aduturai, for their help and guidance in the investigation.

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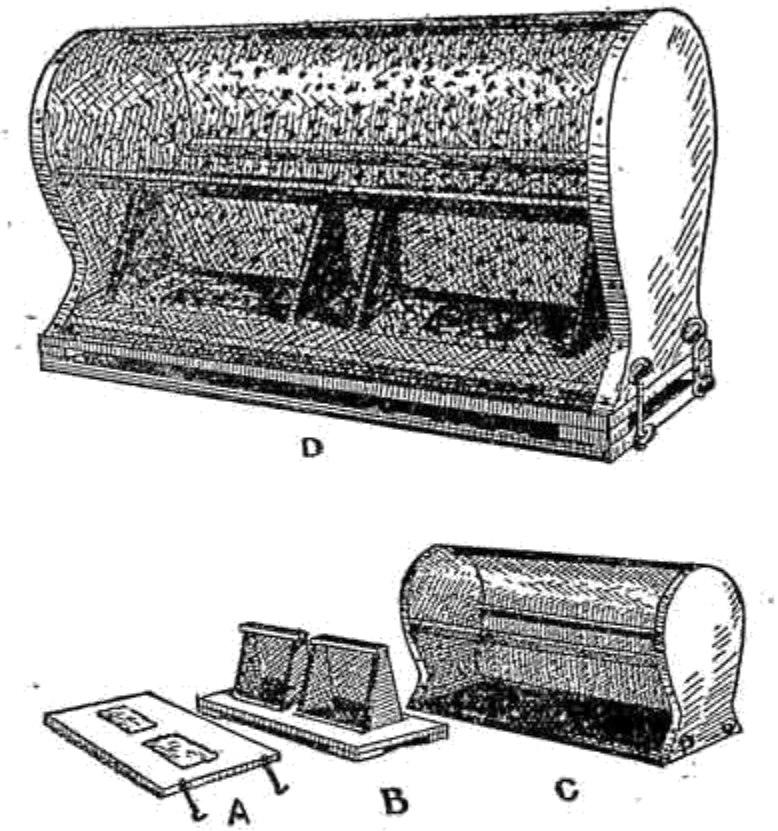

THE MINNESOTA FLY TRAP. (After Washburn)