seedling basis in T (N) 1 combination treatment and its reduction on both panicle and seedling basis in IR 8 indicate varietal differences in the presumed action of DMSO as a penetrant. Data on meiotic irregularities also point in the same direction. Such varietal differences were also evident in the results reported in literature. It is therefore, desirable to carry out detailed studies, by changing the concentration as well as method of application of DMSO before its usefulness for increasing the mutagen action on rice can be ascertained.

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Department of Botany, T V. V. Seftharami Reddi.
Andhra University,
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MANIFOLD MORPHOLOGICAL EFFECTS OF INDUCED DWARFISM IN RICE (*ORYZA SATIVA* L.)

Mutational correction of unwanted traits in the otherwise high yielding and well adapted crop varieties has brought in significant advances in applied plant breeding (Sigurbjornsson *et al.*[8] and Swaminathan[10]). Numerous studies have also shown that major gene mutations often lead to multiple morphological changes which, in view of breeding objectives, may have desirable as well as undesirable effects (Emery *et al.*[2], Kawai and Narahari[4], Scarascia Mugnozza[7], Tanaka[11]). Macro-mutational studies, therefore, are important not only in evaluating their significance in crop improvement but also in evaluating their effects on the coadapted gene complexes and in studying the structure and evolution of complex loci (Bozzini[1], Pandey[5], Swaminathan[9]). In this report, we examine the manifold morphological changes associated with semi-dwarfs in rice varieties—T 141 and GEB 24—which were produced by treating low moisture (4%) seeds with 10 Kr gamma-radiation. The mutant materials used in the study were single plant M_4 seeds derived from uniformly dwarf M_3 progenies which were planted along with their control parental lines in complete randomized block design with three replications on 23rd August 1976 at Agricultural Research Farm, Banaras Hindu University. The plot size was three rows, two meters each, with 30 cm row-to-row spacing and 15 cm within-row spacing. Measurements were recorded on five competitive plants from each entry in each replication.

The mean values for various morpho-physiological characters in T 141 and GEB 24, and their respective mutants, T 141M and GEB 24M, are given in Table I. The natural plant height of the parental lines was substantially reduced due to late planting. However, the plant height of both mutants, further decreased by about 50%, the reduction being higher in GEB 24M than in T 141M. The other characters for which both mutants recorded significant and remarkably

Table I

Mean values for various characters in two tall indica rice varieties T 141 & GEB 24, and their induced dwarf mutants T 141M & GEB 24M

Character	T 141	T 141M	GEB 24	GEB 24M
Plant height (cm)	100·07±1·59	56·80±1·67	111·83±1·20	57·00±2·18
Days to heading	104·27±0·50	108·87±0·66	110·80±0·43	106·13±0·95
Ear bearing tillers	11·40±0·63	12·13±1·04	13·80±1·20	9·20±0·78
Peduncle length (cm)	32·27±0·76	23·69±0·87	31·17±0·22	18·53±1·28
Extrusion length (cm)	3·95±0·57	—2·60±0·81	2·51±0·36	—7·60±1·24
Panicle length (cm)	22·27±0·26	20·84±0·21	23·03±0·51	22·73±0·54
Flag leaf length (cm)	23·57±0·65	17·07±0·66	16·40±0·62	19·00±1·17
Flag leaf width (cm)	0·95±0·032	1·10±0·004	0·74±0·032	1·04±0·032
No. of grains/panicle	204·07±6·25	129·27±5·83	133·00±6·63	116·33±7·24
1000-grain weight(cm)	15·55	20·80	15·55	16·15

lower values as compared to their control parental lines were peduncle length, extrusion length, and number of grains panicle. Panicle length also decreased in both mutants but the reduction was marginal. For flag leaf width and 1000-grain weight, both mutants recorded higher values as compared to their control parental lines. The direction of macromutational effects on the other characters in both the mutants was not consistent. Although the panicle length was only marginally affected, a detailed study of the panicle components, *viz.*, the number and the length of primary and secondary branches along the panicle axis, revealed that these changes were quite pronounced and that the mutants differed in degree rather than in kind (Rai *et al.*[6]). Kawai and Narahari[4] also found in one progeny of the M_2 generation in rice, six short and non-lodging plants which behaved as simple recessives. A detailed study showed that the shortness was due to reduction in the internode length. The other changes associated with dwarfism were reflected in decreased number of tillers; reduction in panicle and grain size, leaf length, spikelet density, and finer grains.

The multiple chages in various morpho-physiological characters associated with dwarfism may be due to pleiotropic effects of major dwarfing genes. And the differential pattern in some characters may be either due to involvement of different dwarfing genes in both mutants, or due to the differential behaviour of the same dwarfing gene in differing genetic background of the parental varieties. Cryptic structural changes involving minute deletions may also lead to multiple changes. Minute deficiencies, when low moisture seeds were exposed to ionizing radiations, were found by Brock to be the frequent events in tomato analyses (see Wallace[12]). And yet, there is the possibility of background mutations which do occur concurrently with the major gene mutations (Gregory[3]).

Department of Genetics
and Plant Breeding,
Banaras Hindu University,
Varanasi,
January 17, 1979.

S. L. Dwivedi.
K. N. Rai.*
R. B. Singh.

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* International Crops Research Institute for the Semi-Arid Tropics, Hyderabad.

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TAPETUM-LIKE ANTHER EPIDERMIS IN *ZEUXINE LONGILABRIS* (LINDL.) BENTH ex HK., ORCHIDACEAE

While studying the anther development in *Zeuxine longilabris* (Lindl.) Benth ex HK., a terrestial semi-saprophytic taxon which produces pollen massulae, we noted an unusual behaviour of the anther epidermis, so far not recorded in any of the angiosperm studied.

A transverse section of a fairly young anther reveals 4 microsporangia (Fig. 1). The anther wall is made up of an epidermis, an endothecium, a middle layer and the tapetum (Fig. 2). At the time of meiosis and quadripartition of microspore mother cells, the uninucleate glandular tapetal cells become conspicuous. But by the time the microspore nuclei begin to divide, the tapetum and the middle layer breakdown and degenerate. The endothecial cells enlarge in size radially. The epidermal cell, stretch tangentially and acquire dense protoplasm and some of them even become multinucleate when the microspore divides (Fig. 3). The nuclei of the epidermal cells frequently fuse to form large irregular polyploid nuclei. During subsequent development, when the pollen grains become two-celled in the massulae and accumulate starch, the endothecial layer develops band-like thickening on the inner surface of tangential walls, while the conspicuous epidermal cells show signs of degeneration (Fig. 4). At the time of shedding of pollen massulae the epidermal cells break down completely and form a thin membrane outside the fibrous endothecium (Fig. 5).

The above account on the behaviour of the epidermis of the anther wall clearly indicates that histologically, *i.e.*, in the enlargement of cells, in the acquisition of dense cytoplasm containing more number of nuclei, presence of nuclear fusion within the cell, and final degeneration, the layer appears more like a tapetum,