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Radio-sensitivity and Response to GA Treatment in the Sub-species of *Oryza*

by

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Introduction : The response of a genotype to the external application of gibberellic acid (GA) is an index of the level of endogenous gibberellin content (Ecklund and Moore, 1968). Radio-sensitivity of a genotype depends upon the changes in endogenous levels of auxin and ascorbic acid (Sparrow and Christensen, 1953). To find out the differences in radio-sensitivity, if any, of the two sub-species of *Oryza*, and to correlate with their response to the external application of GA, an experiment was conducted in two varieties of paddy viz., S_{705} and Taichung-65 belonging to 'indica' and 'ponlai' groups respectively.

Materials and Methods : Seeds of S_{705}, of '*indica*' group and Taichung-65 a '*ponlai*' type collected from selfed plants were dried uniformly and brought to uniform moisture content. Seeds were treated with four ml of distilled water or GA solutions of 10^{-3}, 10^{-4}, and 10^{-5}M concentrations. Twenty seeds were planted in each petriplate and the height of seedlings was measured on the sixth day. The treatments were replicated four times.

In another experiment, 500 seeds per treatment were irradiated with gamma rays from the gamma cell installed in the Botany Division, Indian Agricultural Research Institute, New Delhi, with the source strength of 2000 Cu of Co^{60}, at a dose rate of 3000 rads per minute with the doses of 20 Kr, 30 Kr and 40 Kr. Fifty seeds from each treatment were laid out for germination tests in petri plates in two repeats. The seedling growth was recorded on the seventh day. The seedlings raised in nursery were transplanted in field to raise M_1 generation. First formed five tillers in M_1 plants were tagged and harvested separately. To raise M_2 generation, the population was grown by dibbling the deeds on spike progeny basis on 10' long rows. In M_2, chlorophyll mutations were scored in seedling stage and viable mutations were scored periodically, throughout the growing period and after maturity and the mutation frequency was expressed on M_2 plant basis.

Experimental results : The seedling growth taken on six days old seedlings of GA treatment is represented in Fig. 1. The seedling height in untreated seeds of S_{705} was 23 mm and it was 31.60 mm and 32.95 mm in seedlings raised from seeds treated with GA 10^{-5} and 10^{-4}M respectively. But at a higher concentration of 10^{-3}M, the seedling growth showed a negative trend (28.48 mm). In case of Taichung-65, the height of control seedlings was

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FIG. 1. SEEDLING HEIGHT IN PADDY TREATED WITH GIBBERELLIC ACID

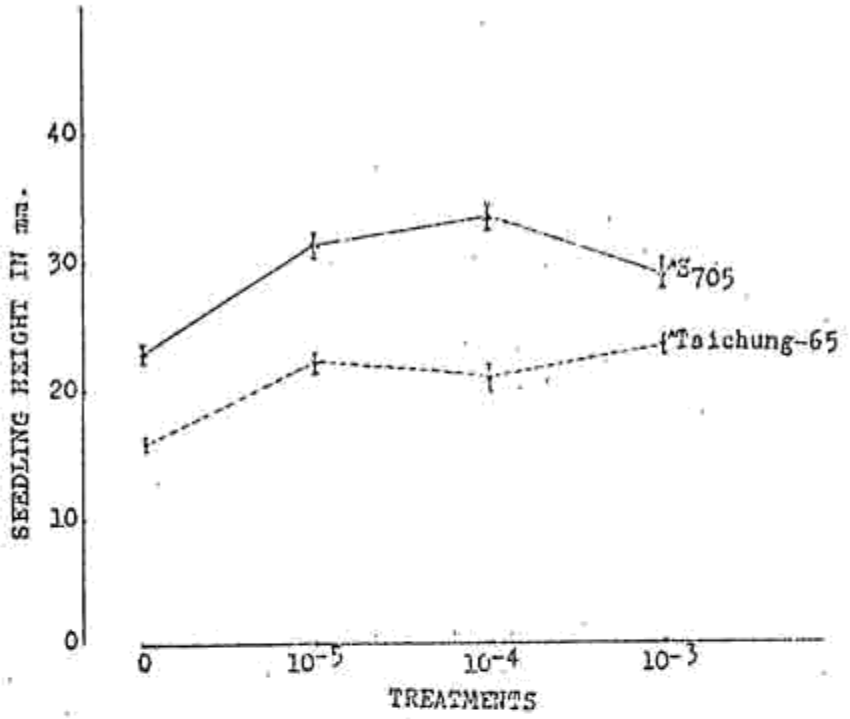
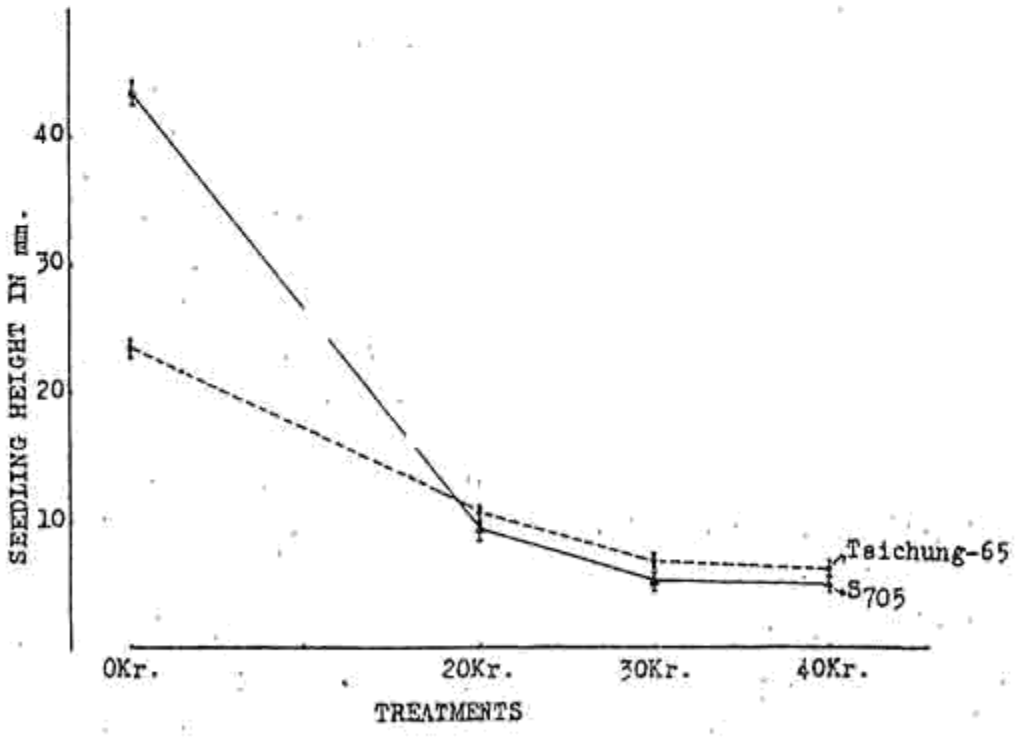


FIG. 2. SEEDLING GROWTH IN IRRADIATED PADDY



15.15 mm and it was 22.45 mm in seedlings in treatment GA 10^{-5}M. There was no appreciable increase in the height of the seedlings with higher concentrations of GA. The difference in the height of seedlings of S_{705} and Taichung-65 treated with GA 10^{-5}M was 9.15 mm and it was 11.55 mm in case

of seedlings treated with 10^{-4}M solution. At a given concentration of GA, the height of seedlings was always lesser in Taichung-65 compared to the height of the seedlings in S_{705}. The two sub-species i. e., '*indica*' (S_{705}) and '*japonica*' (Taichung-65) respond differently to GA treatment. S_{705} is more responsive to the external application of GA whereas Taichung-65 is comparatively less responsive to the exogenous GA treatment.

The seedling growth in irradiated seeds measured on the seventh day is represented in Fig. 2. In case of seedlings raised from un-irradiated seedlings it is observed that height of S_{705} seedlings is only 9.67 mm whereas in Taichung-65 it is 10 1 mm and there is corresponding decrease with increasing dosage. An interesting observation is that the decrease in seedling height due to radiation effect is more in S_{705} compared to that observed in Taichung-65. '*Indica*' type (S_{705}) is highly sensitive to irradiation but '*japanica*' types (Taichung-65) is comparatively less sensitive to radiation effect.

M_2 Generation : The mutation frequency in M_2 generation as measured by chlorophyll and viable mutations is represented in Table 1. It is observed

TABLE 1. *Mutation frequency in M_2 population irradiated with 20 Kr gamma rays.*

Variety	No. of M_2 plants scored	Chlorophyll mutations							Viable mutations				Mutation frequency (%)
		Albino	Xantha	Viridis	Albo Viridis	Chlorina	Tigrina	Striata	Early	Dwarf	Tall	Compact	
S_{705}	6322	48	17	1	26	21	3	1	13	7	—	3	2.53
Taichung-65	5946	64	—	—	3	8	—	23	8	2	1	—	1.83

that the mutation frequency in S_{705} is higher than the mutation frequency in Taichung-65. A wide spectrum of chlorophyll mutations is observed in S_{705} compared to Taichung-65, whereas the spectrum of viable mutations is comparatively narrow in both the varieties.

Discussion : The effect of external application of GA on cell division is abundantly clear. The difference in cell size accounts for a proportion of the tremendous growth responses frequently recorded following gibberellin treatment. The most satisfactory explanation for the mechanism of gibberellin action is increased protein synthesis, cell division, auxin production and cell expansion. As a consequence, some of the gibberellin effects may be considered as expressions of increased auxin supply (Paleg, 1965). It appears that the differential response of the two varieties to the external application of GA is a reflection of their differences in the endogenous levels of gibberellin content, that Taichung-65 has a higher level of gibberellin content compared to S_{705}.

It has been shown by Sparrow and Christensen (1953) that the response of a genotype to the radiation effect depends upon the endogenous levels of auxin and ascorbic acid. The reduction in seedling height of irradiated seeds is due to inhibition of auxin synthesis (Gordon, 1957). S_{705} is more sensitive to radiation compared to Taichung-65. It appears that gamma irradiation impairs a possible endogenous gibberellin synthesizing system (Mathur, 1961), so that in S_{705} which seems to have lower level of endogenous GA, the growth reduction is too drastic compared to the extent of reduction in growth observed in Taichung-65, which apparently has a higher level of auxin content. However, further studies are under way to establish this hypothesis.

The response of a variety to mutagen treatment in producing mutation is usually worked out on the basis of the frequency of chlorophyll mutations or frequency of viable mutations for a particular locus (like Q locus in wheat) (Mackey, 1959). In the present study, the mutation frequency is worked out on the basis of chlorophyll and viable mutations. However mutation frequency on M_2 plant population basis is a correct assessment of the mutational events (Gaul, 1958). It is seen that S_{705} is highly mutable compared to Taichung-65 at 20 Kr dose. Hence, it appears that there are varietal differences in their radiosensitivity, and the radio-sensitivity is intimately correlated with the response of the variety to the external application of GA. So, it can be hypothesized that the variety which is less responsive to the application of GA is mutable. If this hypothesis holds good, there is scope to believe that the sub-species of *Oryza* differ widely in their radio-sensitivity. '*Japonica*' (Taichung-65) varieties are less sensitive compared to '*indica*' types (S_{705}).

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REFERENCES

Ecklund, P. R., and T. C. Moore. 1968. Quantitative changes in Gibberellin and RNA correlated with senescence of shoot apex in the 'Alaska pea'. *Amer. J. Bot.*, 55 : 494–503.

Gaul, H. 1958. Recent aspects of induced mutations in plant breeding *Euphytica*, 7 : 275-89.

Gordon, S. A. 1957. The effects of ionozing radiation on plants. Biochemical and physiological aspects. *Quart. Rev. Biol.*, 32 : 3–14.

Goud, J. V., K. M. D. Nayar and M. G. Rao. 1967. Effects of gamma irradiation on germination and growth of some varieties of paddy. *Mys. J. Agri. Sci.*, 1 : 227–31.

Mackey, J. 1959. Mutagenic response in Triticum at different levels of ploidy. *Proc. Firs-Internl. wheat Symp. Winnipeg, Canada*, 1958. 88–111.

Mathur, P. B. 1961. Reversal of gamma ray induced dormancy of potato tubers by gibberellic acid. *Nature*, 190 : 547–48.

Paleg, L. G. 1965. Physiological aspects of Gibberellins. *Ann. Rev. Pl. Physiol.* 16 : 291–322.

Sparrow, A. H., and E. Christensen. 1933. Tolerence of certain higher plants to chronic exposure to gamma radiation from Cobalt 60. *Science*, 18 : 697–98.

Orlob, G. B. and D. C. Arny. 1961, Some metabolic changes accompanying infection by barley yellow dwarf virus. *Phytopathology*, 51 : 768-75.

Promekanon, Y., G. K. Barat and N. B. Das. 1963. Distribution of phosphatases in leaf, stem and root of wheat plant during reproductive period. *Indian J. exp. Biol.*, 1 : 95-97.

Smith, J. H. C. and A. Beintez. 1955. Chlorophylls : Analysis in Plant materials. *Modern methods of plant analysis*, 4 : 142-96.

Stalfelt, M. G. 1956. Morphologic and Anatomic des Blattes als Transpirationsorgan. *Handb. PfiPhysiol.*, 3 : 324-41.

Stocker, O. 1956. Messmethoden der Transpiration. *Ibid* 3 : 697-741.

Waker W. E. C., M. P. Gordon and J. W. Huff. 1963. Metal content of tobacco mosaic virus RNA. *Biochemistry*, 2 . 716-19.

Willstatter, R. and A. Stoll. 1928. *Investigations on chlorophyll*. Translated by F. M. Schertz and A. R. Merz. Science Press, Lancaster, Pa.
