400° C. for 3 hours. The similarity of the two curves further reinforces the fact that during the dehydrogenation reaction, the surface of nickel oxide is reduced to the metallic state. Thus starting from a pure metal oxide catalyst, a metal-on-metal oxide is obtained during the reaction. This means that the process of catalyst preparation cannot, strictly speaking, be considered as finished at the moment when the reaction starts. If one may so express it, the final preparation of the catalyst occurs in the process of reaction itself.

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SENSITIVITY TO GIBBERELLIC ACID IN RELATION TO DWARFING AND HARVEST INDEX IN BREAD WHEAT

B. BALDEV AND M. S. SWAMINATHAN
Division of Genetics, Indian Agricultural Research Institute, New Delhi-12, India

IT is well known that several genetic dwarfs in crop plants become tall when given an exogenous application of gibberellic acid (GA_3).[1] Allan and his co-workers[2] have studied the comparative response to GA_3 of dwarf, semi-dwarf and standard short and tall winter wheat varieties. They found that the dwarf and semi-dwarf varieties though responsive to applied GA_3 were not induced to grow to normal height, whereas standard-height varieties were stimulated significantly. All of these were winter varieties and GA_3 was applied after plants were exposed to low winter temperatures. The 'Norin' dwarfing genes introduced from Japan in wheat breeding programmes in the United States, Mexico and other countries after World War II have led to a major yield breakthrough in bread wheat by enabling the repatterning of the plant architecture in a manner suited for high levels of application of fertilizer and water.[3] The present study was undertaken to assess the reaction of wheat varieties possessing the 'Norin' dwarfing genes to the application of GA_3.

The following seven varieties were chosen for the study : two tall Indian varieties (C. 591 and N.P. 824) a γ-ray-induced dwarf mutant of N.P. 824, two semi-dwarf varieties developed in Mexico (Sonora 64 and Lerma Rojo), an experimental strain possessing 3 major genes for dwarfing (Triple dwarf) and an induced amber-grain mutant of Sonora 64 which was released for cultivation in India under the name Sharbati Sonora.[4] Monosomic analysis revealed that Lerma Rojo has a recessive gene for dwarfing in chromosome 6D and Sonora 64 and Sharbati Sonora have two such genes in chromosome 2A and 4D.[5] The triple dwarf had all the three genes with a reducing effect on height. An analysis of the pathway through which the varieties with 'Norin' dwarfing genes give high yields showed that besides being able to utilise more fertiliser because of the favourable morphological frame, they also had a better harvest index (*i.e.*, the ratio of grain to total dry matter, Table I).

TABLE I

Variety	Total dry matter yield (tonnes/hectare)	Harvest index
C. 591 ..	10·30	0·29
N.P. 824 ..	10·60	0·33
Dwarf mutant of N.P. 824	9·00	0·27
Lerma Rojo ..	11·00	0·50
Sonora 64 ..	11·00	0·55
Sharbati Sonora ..	11·00	0·55
Triple dwarf ..	10·50	0·67

The procedure for assessing sensitivity to GA_3 was as follows : Grains were soaked on three layers of filter-paper in petri plates containing five ml distilled water. The seeds

were so arranged that their grooved side faced the filter-paper. They were maintained at 15° C. inside an incubator for 48 hours by which time the coleoptile showed emergence.

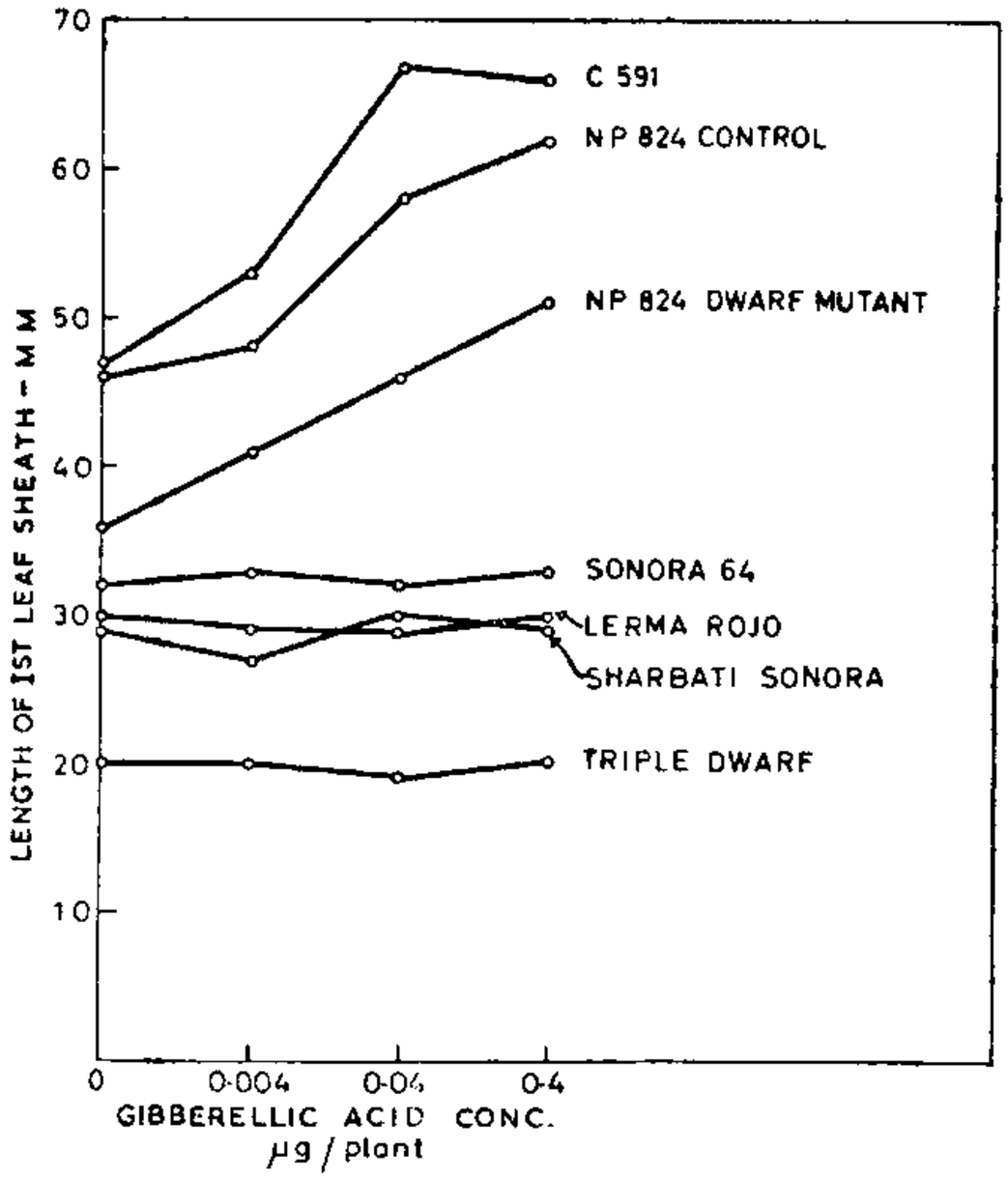

FIG. 1

Germinated seeds with a uniform length of coleoptile were selected and five such seeds were transferred to a flat bottom tube (3" × 1" dia.) three-fourth filled with 1% gelled agar and kept in continuous light at 25° C. In order to avoid drying up of these seeds, they were covered with a thin plastic sheet for another two days. By this time the root system was well established and seedlings were able to draw water from agar. At the end of this period, a 2µl drop of GA_3 solution prepared in 0·05% Tween-80 was applied to the tip of coleoptile. Five plants per treatment were used. The seedlings continued to grow in continuous light and distilled water was added as and when necessary to avoid desiccation of agar. As elongation of the first leaf-sheath stops after the emergence of the second leaf, the length of the first leaf-sheath was recorded at this stage. Depending upon the variety, this takes 5 to 6 days after GA_3 application. Three concentrations of GA_3, 0·004, 0·04 and 0·4 µg per plant were used. The seven varieties used could be broadly classified into two major groups as GA_3 sensitive and GA_3 insensitive (Fig. 1). The dwarf varieties possessing 'Norin' genes were not sensitive to the GA_3 amounts used in this study while the induced dwarf mutant of N.P. 824 responded to the treatment. The two tall varieties also responded to the treatment of gibberellic acid.

The induced dwarf of N.P. 824, which had been isolated in 1959 in the M_2 progenies of 16 Kr γ-ray-treated material, is not only about 20 cm. shorter in height than the parent, but has also more dense ears. Attempts to get high-yielding segregates from crosses involving this mutant have not so far been successful, in view of the pleiotropic association of plant height with ear density and spikelet number. The 'Norin' dwarfing genes, on the other hand, do not have such undesirable pleiotropic effects. It would be worthwhile examining all dwarfs of breeding value in crop plants for GA_3 sensitivity in order to ascertain whether generally dwarfs in which reduction in height is not due to a block in the endogenous synthesis of gibberellins are only capable of giving a high harvest index.

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