Among the palm species studied, two major categories seem to exist—species with leaves developing 'haut' (*e.g., Phœnix, Elæis,* etc.) and those without 'haut' (*e.g., Borassus, Cocos,* etc.).

The interpretation of the palm leaf—whether it is simple or compound—has been an interesting subject. Eames (1953) advanced the view that the palm leaf is simple in nature and the mechanism of leaflet formation is quite different from that in the compound leaf of dicotyledons. In the palm leaf, the leaflets are cut out of the lamina the margin of which is left unaffected holding the leaflets together until unfolding. The leaflets of palms do not have separate initials nor do they exhibit apical or marginal growth typical of dicotyledonous leaves. The very existence of an exceptional type of development in palm leaves has been the cause of confusion in the literature.

I am indebted to Dr. K. Periasamy for kindly discussing his views and to Prof. B. G. L. Swamy for very kindly providing me with facilities.

1. Eames, A. J., *Phytomorphology*, 1953, **3**, 172.
2. Padmanabhan, D., *Proc. Natl. Inst. Sci., India*, 1963 (In Press).
3. Periasamy, K., *Phytomorphology*, 1962, **12**, 54.
4. Venkatanarayana, G., *Ibid.*, 1957, **7**, 297.
5. Yampolsky, C., *Bull. Jard. Bot. Buitenzorg, Ser.* 3, 1922, **5**, 107.

INDUCED SPHAEROCOCCOID MUTATIONS IN *TRITICUM AESTIVUM* AND THEIR PHYLOGENETIC AND BREEDING SIGNIFICANCE

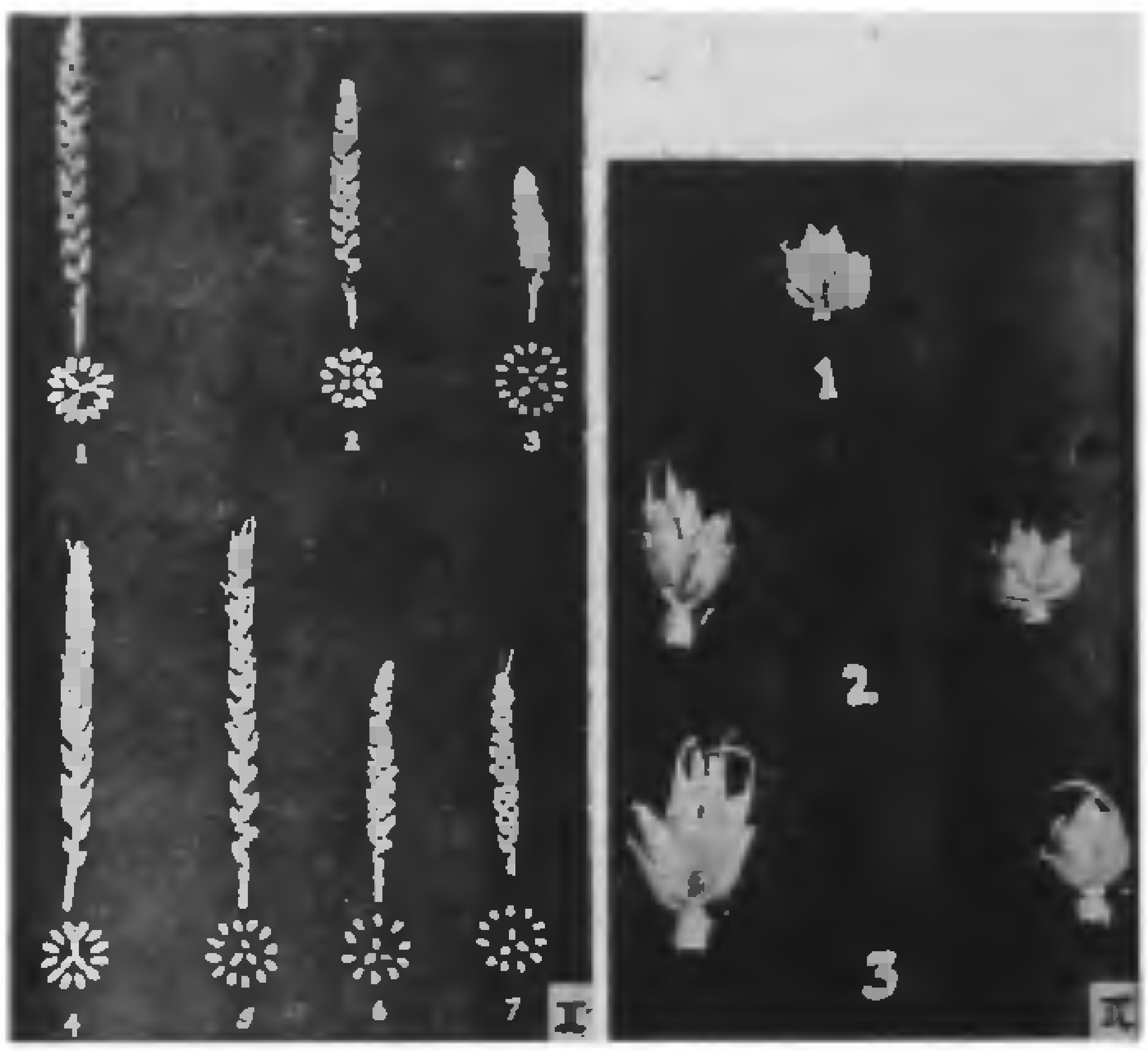
M. S. SWAMINATHAN, D. JAGATHESAN AND V. L. CHOPRA
Division of Botany, Indian Agricultural Research Institute, New Delhi

THE dwarf Indian wheats with dense ears and spherical grains, described by Howard and Howard[1] as varieties of *Triticum compactum* Host., were assigned specific status by Percival[2] and named *T. sphærococcum*. *T. sphærococcum* differs strikingly from the other hexaploid ($2n = 42$) *Triticum* species in its rigid, erect and abruptly tapering leaves, small dense ears with inflated glumes and hemispherical grains. Its grains have been found in the excavations at Mohenja Daro in Sind.[3] In crosses between *T. æstivum* and *T. sphærococcum*, the whole constellation of characters peculiar to the latter tends to be inherited as one recessive gene and hence Ellerton[4] postulated that *T. sphærococcum* probably arose through the deletion of a chromosome segment in *T. æstivum*. Sears[5] showed that the *sphærococcum* gene *S* is located on chromosome 3 D (XVI). There has been considerable interest among wheat breeders in transferring the spherical grain character of *T. sphærococcum* to the cultivated bread wheats since a round grain is ideal from the milling point of view.[6] Attempts in this direction have however not been successful.[7] The scope for isolating either spontaneous or induced mutants in *T. æstivum* possessing *sphærococcoid* grains is hence worth exploring.

In the course of our studies on the frequency and spectrum of mutations occurring in the progenies of several varieties of *T. æstivum* subjected to treatment with different physical and chemical mutagens, we have isolated two different types of *sphærococcoid* mutants. A mutant having erect and rigid leaves, shorter stature and ears as compared to the control and inflated glumes and hemispherical grains was found in the M_2 generation of the variety N.P. 799 treated with UV (1 hour) and 2·5 μc. per seed of S^{35} (Figs. 1 and 2). This mutant is true breeding and possesses the rust resistance and other morphological traits of the parent strain. In crosses between the parent variety and the mutant, a single recessive factor was found to control the mutant phenotype. No segregation for the *sphærococcoid* complex of characters occurred in the F_2 progenies of reciprocal crosses between the mutant and *T. sphærococcum*, thereby suggesting that this mutant has the same *S* gene as in *T. sphærococcum*.

Another type of *sphærococcoid* mutation giving rise to phenotypic characters resembling closely that of the mutant described recently by Schmidt and Johnson[8] occurred in six different varieties treated with different concentrations of ethyl methane sulphonate (EMS). The earliest to be recorded was in the M_2 progeny of the strain H. 389 treated with 300 p.p.m. of EMS. This mutant had stiff and erect flag leaves with a cup-like ending, long and lax ears, hemispherical glumes and round grains.

The progenies of 2 such mutants contained 23 *sphærococcoid* and 9 normal *æstivum* type plants. There was also segregation for ear density largely through the folding of the rachis in an "accordion" fashion (Fig. 1). This



FIGS. 1–2. Fig. 1. (1) Ear and grains of N.P. 799. (2) Ear and grains of *sphærococcoid* mutant of N.P. 799. (3) Ear and grains of *T. sphærococcum*. (4) Ear and grains of H. 389. (5, 6 and 7) Ears and grains of *sphærococcoid* mutants of H. 389 showing different degrees of ear density. Fig. 2. (1) Spikelet of *T. sphærococcum*. (2) Spikelets of control (left) and *sphærococcoid* mutant (right) of N.P. 799. (3) Spikelets of control (left) and *sphærococcoid* mutant (right) of H. 389.

mutant has been crossed with the parent strain as well as with *T. sphærococcum*. Schmidt *et al.*[9] have found that the gene governing the *sphærococcoid* characters in their mutant is incompletely dominant and is not allelic to the *sphærococcum* gene.

The breeding behaviour of the *sphærococcoid* mutants in H. 389 also suggests that the gene involved should have an incompletely dominant effect and cannot be a hemizygous ineffective one as is the case with the *S* locus of *T. sphærococcum*.

The isolation of a *spœrococcoid* mutant in *T. durum* by Schmidt and Johnson[8] suggests that a mutation in a A or B genome chromosome could also give rise to characters simulating the *S* gene effect in chromosome 3 D. The location of the gene responsible for the second type of *sphærococcoid* mutant isolated by us is not yet known but it seems probable from the identity of this type both in phenotype and dominance relationship with that isolated and studied by Schmidt and Johnson[8] that the *S* locus in chromosome 3 D is not involved. The possibility of obtaining different types of *sphærococcoid* mutations raises the hope that *T. æstivum* strains possessing round grains but not the other attendant characters like short and dense ear and stiff leaves as in *T. sphærococcum* can be evolved. The recurrence of the second type of *sphærococcoid* mutation in EMS-treated progenies of different varieties and its absence in other treatments suggests that this locus may be selectively affected by this mutagen.

The *sphærocococcoid* mutants obtained by us have high fertility and regular meiosis. The allelic identity of the N.P. 799 mutant with the *S* locus of *T. sphærococcum* further strengthens the view that the latter species arose as a recessive mutation in *T. æstivum*. Its high drought tolerance appears to have been responsible for its preferential survival in North-Western Pakistan.

1. Howard, A. and Howard, G. L. C., *Wheat in India*, Calcutta, 1910.
2. Percival, J., *The Wheat Plant—A Monograph*, Duckworth, London, 1921, p. 463.
3. Marshall, J., *Mohenjodaro and the Indus Civilization*, London, 1931.
4. Ellerton, S., *J. Genet.*, 1939, **38**, 307.
5. Sears, E. R., *Genetics*, 1947, **32**, 102.
6. Newton, R. and Malloch, J. G., *Sci. Agric.*, 1925, **6**, 1.
7. Singh, R. D., *Ind. J. Genet.*, 1946, **6**, 34.
8. Schmidt, J. W. and Johnson, V. A., *Crop Science*, 1963, **3**, 98.
9. —, Weibel, D. E. and Johnson, V. A., *Ibid.* 1963, **3**, 261.