An extreme dwarf mutant in sunflower

In diploid plants radiation-induced mutations are observed in the M_2 generation, while in the case of polyploids like durum and bread wheat, mutants also appear in the M_3 and M_4 generations[1]. X-ray-induced mutants were isolated up to X_6 generation in groundnut[2]. In this paper, an extreme dwarf mutant observed in the M_9 generation of the diploid sunflower variety 'Surya' is reported. The morphological characters and segregation ratio of this mutant have been studied

'Surya' is the first high-yielding variety released for cultivation in India. Using gamma radiation, a large spectrum of variability for morphological and seed coat colour characters has been isolated[3]. Selection in the black seed coat colour mutants resulted in the development of more than 100 breeding lines for seed yield. These lines are being evaluated for yield potential. Extreme dwarf plants were observed in the M_9 generation of the black seed coat line TS 33E7. There were 12 dwarf plants in this 5-row plot. Three out of 12 dwarfs survived to maturity. Data on the morphological characters from seedling to maturity were recorded.

The significant attribute of the mutant was the drastic reduction in the plant height to 11.66 cm (Figure 1) compared to 180 cm of the control. The dwarf mutant was slow-growing. Head diameter (7.76 cm), length of leaf (10.72 cm), breadth of leaves (9.17 cm) and length of ray florets (2.18 cm) were reduced to approximately half compared to the control plant. The length of petiole (4.82 cm) was decreased to one-third and number of ray florets, stem diameter and breadth of ray florets were also lowered significantly. However, the total number of leaves (34) and leaves at flowering were the same as in normal plants. Leaves were dark-green and wrinkled, with small serration. Petioles were placed one above the other, with no discernible internode.

Figure 1. An extreme dwarf mutant with approximately 12 cm plant height and straight head at flowering.

The normal plants flowered in 47 days and matured in 97 days, whereas the dwarf mutant flowered in 123 days and matured in 172 days. After flowering, unlike normal sunflower, the head did not respond to sunlight but remained straight (Figure 1). The disc florets were sterile. The stigma with a small style emerged out of the disc florets. Anthers were absent in the anther tube. Disc florets at the centre were not opened fully and stigma emergence was less. No seed formation was observed at maturity. Thus, dwarfness and male sterility were found to be associated with each other. Studies on linkage of these characters are in progress.

In the M_9 generation, the plant-to-row progenies of TS33E7 segregated into 45 normal and 12 dwarf plants. The segregation fits well into the monogenic ratio of 3 : 1 (chi-square, 0.209; *P*-value; 0.9–0.8). It indicated that dwarfness is controlled by a single recessive gene. Seeds from the mutant could not be harvested, because it was sterile and late. All the normal sister plants were selfed at flowering to isolate the dwarf mutant from heterozygous plants in the next generation. When 20 normal, selfed sister plants were sown in plant-to-row progenies in the M_{10} generation, 12 plants were true-breeding for normal plant height and eight plants showed segregation for dwarf and normal plants. Two plant progenies segregated in 27 : 7 (normal : dwarf) and 100 : 10 (normal : dwarf). Segregation in the other six progenies is not mentioned due to less plant population. Thus, no fixed segregation was observed in the M_{10} generation. However, detailed genetic studies are being carried out. Fick[4] has reported single recessive gene control for reduced plant height in sunflower. Appearance of mutants in diploids in generations later than M_2 is a rare event. Delayed expression of this extreme dwarf mutant in the M_9 generation could be due to maintenance of the genes in heterozygous condition in the previous generations because of cross-pollination in sunflower, or it may be a natural mutation or activation of unstable elements. This needs detailed analysis.

Lodging and stalk breakage caused by excessive growth are known to be associated with yield reduction in sunflower. Therefore development of dwarf and semi-dwarf varieties or hybrids is one of the major breeding objectives. In India Morden (Cerenianka-66) is the only dwarf (66–110 cm) and early maturing variety available for cultivation. Worldwide, only three sources of reduced plant height in sunflower namely DDR (90.3 cm), Donsky (65.5 cm), and Donskoi 47 (79.8 cm) have been reported so far[5–7]. However, this is a report of extreme reduction in the plant height of sunflower to 11–12 cm. This source could be nominated as 'TDS' (Trombay Dwarf Sunflower). This novel source of dwarfing gene could be exploited to alter plant architecture in sunflower, to develop high-yielding varieties and hybrids.

1. IAEA, *Manual on Mutation Breeding*, Tech. Rep. Ser. No. 119, 1997, 2nd edn.
2. Patil, S. H., *Indian J. Genet.*, 1966, **26A**, 334–348.
3. Jambhulkar, S. J. and Joshua, D. C., *Helia*, 1999, **22**, 63–74.
4. Fick, G. N. *Agron. Monogr.*, 1978, **19**, 279–337.
5. Miller, J. F. and Hammond, J. J., *Euphytica*, 1991, **53**, 131–136.
6. Berretta de Berger, A. M. and Miller, J. F., Proceedings of the 6th Sunflower Forum, Bismarck ND, 1985, p. 11.
7. Herring, M. J., *Oilseed News*, December 1985, 12–14.

ACKNOWLEDGEMENTS. I thank Mr Narendra Puri Goswami for his critical observations in the field.

Received 11 February 2002; revised accepted 2 May 2002

SANJAY J. JAMBHULKAR

Nuclear Agriculture and Biotechnology Division,
Bhabha Atomic Research Centre,
Mumbai 400 085, India
e-mail: sjj@apsara.barc.ernet.in