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RESPONSE OF TWO SESAME CULTIVARS TO SEED IRRADIATION WITH GAMMA RAYS.

R. PATHIRANA AND SANDYA SUBASINGHE
Department of Agricultural Biology, University of Ruhuna, Kamburupitiya.

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Abstract : Due to a high degree of variation in the radiosensitivity of sesame (*Sesamum indicum* L.), two recommended cultivars with different morphological characteristics were studied in detail for sensitivity to seed irradiation. The experiment was conducted in four replicates with the MI2 and MI3 cultivars. When growth reduction, plant survival and germination were considered as criteria of radiosensitivity, MI3 was more tolerant to irradiation than MI2. Fifty per cent reduction of different growth parameters was achieved with 500 - 700 Gy in MI2 and 750 - 1250 Gy in MI3. Lower doses may be more useful in mutation breeding experiments. It is clear that the radiosensitivity of a cultivar has to be estimated before mutation breeding studies.

Key words: Radiosensitivity, *Sesamum indicum*, gamma rays, mutation breeding, seed irradiation.

INTRODUCTION

Establishment of the optimal dose levels for mutagens is a primary requirement for the success of mutation breeding in different crop species.[1,2] Compared to many other oilseed crops sesame (*Sesamum indicum* L.) seeds are considered to have greater tolerance to irradiation.[3] Nevertheless, there is great variation among different sesame genotypes in their response to seed irradiation. Thus, gamma ray doses of 600-800 Gy were lethal or semi-lethal for the seeds of Egyptian variety Giza whereas Thai varieties have shown no reduction in plant height or the number of capsules up to 600 Gy.[4,5] Gamma rays in the range of 100 Gy to 1400 Gy have been used for mutation induction in six Indian cultivars.[6]

Considering the wide variation in reaction to seed irradiation observed in cultivars of different origin, two morphologically dissimilar sesame cultivars MI2 and MI3 were selected for study.

METHODS AND MATERIALS

Cultivar MI2, the highest yielder in multilocational trials in Sri Lanka, has a basal branching habit, one capsule per leaf axil and black seeds. The only cultivar with white seeds recommended for cultivation in Sri Lanka is MI3. It produces three flowers per leaf axil, has a non branching stem and its opposite phyllotaxy results in a clustered arrangement of capsules on the stem.

Seeds of MI2 variety were irradiated with ten doses of gamma rays from 100 Gy to 1000 Gy at 100 Gy intervals. The variety MI3 was irradiated with 250, 500, 625, 750, 875, 1000, 1125, 1250,1375, 1500 and 1750 Gy doses. About 5 g seeds at 13% moisture were used for irradiation with each dose (1000 seed weight =3.1g). Higher doses had to be used on MI3 variety bacause of its relatively greater resistance shown in previous experiments.[7] Irradiation was carried out at the Central Agricultural Research Institute, Gannoruwa, Peradeniya. Immediately after irradiation, the seeds were sown in the experimental field of the Institute of Fundamental Studies at Kengalla in the mid country intermediate zone during April 1990 at the onset of the southwest monsoon season.

Two hundred seeds per dose per variety were sown in a randomized complete block design with four replications. Non-irradiated seeds served as the control. Seventeen plants per replicate were randomly chosen and tagged for measurement of plant height, number of leaves and nodes at five day intervals. Another batch of 20 plants per replicate were uprooted 15 d after germination to estimate the fresh and dry weight of the plant, shoot and root length and other sedling characters.

RESULTS AND DISCUSSION

The results of seed germination and phenological observations are given in Figures 1 and 2. Increase in radiation dose did not adversely affect the germination per cent in both cultivars. Therefore, the common observation that sesame seed is relatively tolerant to irradiation[3] is confirmed in our experiments with MI2 and MI3 cultivars.

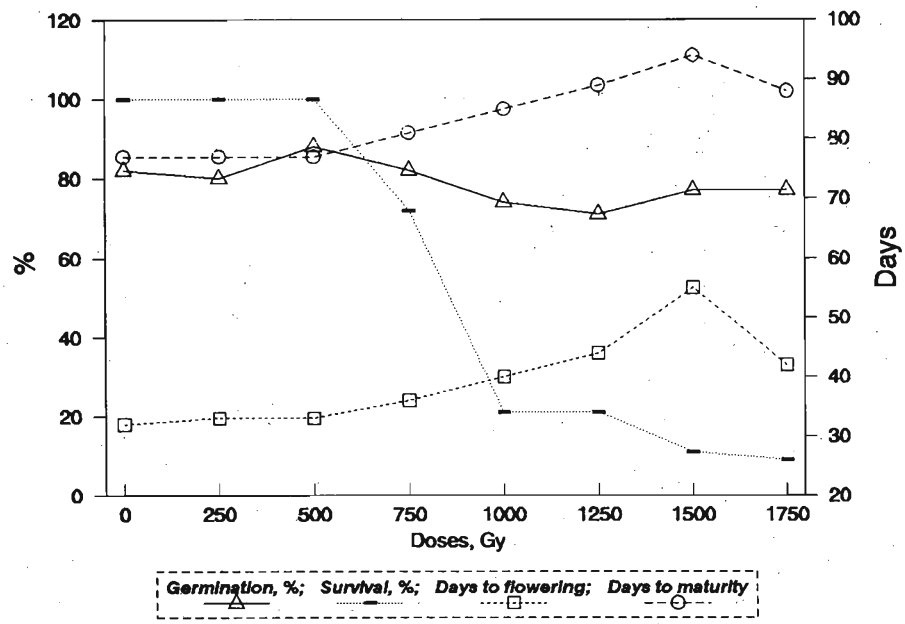

Figure 1 : Germination, phenology and survival of gamma ray treated sesame seeds of MI3 cultivar.

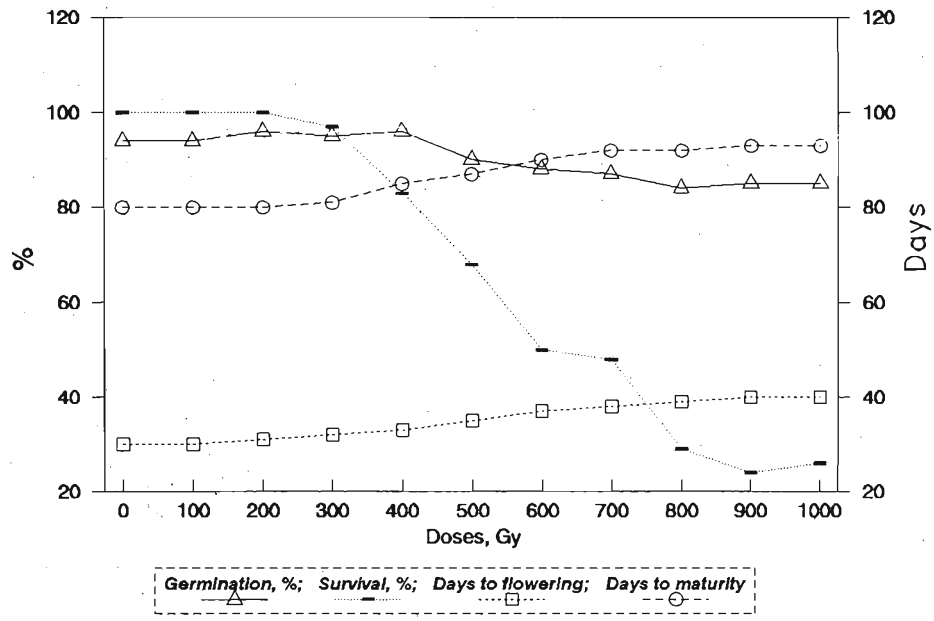

Figure 2 : Germination, phenology and survival of gamma ray treated sesame seeds of M12 cultivar.

With the increase in radiation dosage, the growth and development of the emerged seedling were retarded. The flowering and maturity of plants were delayed by about 10 days or more in MI2 at doses greater than 800 Gy and in MI3 at doses higher than 1000 Gy. Although the germination was not affected, many seedlings of high dose treatments failed to survive at later stages of development. There was no appreciable effect on plant survival in treatments with lesser than 625 Gy in MI3 and 400 Gy in MI2, but it was drastically reduced when the dosage was increased further. Survival was about 50% in the 875 Gy treatment in MI3 and 600 Gy in MI2 (Figs. 1 and 2).

Growth reduction in irradiation experiments is very often expressed by plant height.[1,2] The plant height in our experiment was recorded every five days and the data at 10,20, and 30 days are presented in Figures 3 and 4. Fiftly per cent growth reduction (GR 50 value) at every stage of growth of MI3 variety was between 875 and 1250 Gy. For MI2 variety the doses required to cause GR 50 were lower and ranged from 500 - 700 Gy. In the highest doses used, the plant height was reduced by almost three times compared to the control.

Even the plants derived from the highest dosage recorded about 70% of the number of nodes and leaves of the control. This indicated that the plant height reduction is brought about mainly by the shortening of the internode. Therefore, plant height is a better criterion for growth reduction studies than the number of nodes or leaves on the stem.

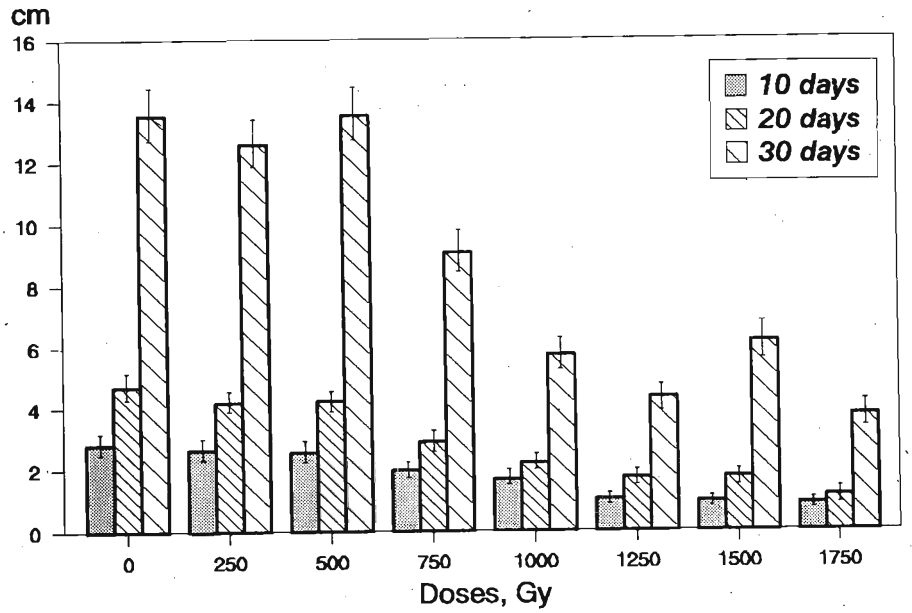

Figure 3 : Seedling height of MI3 cultivar treated with different doses of gamma rays.

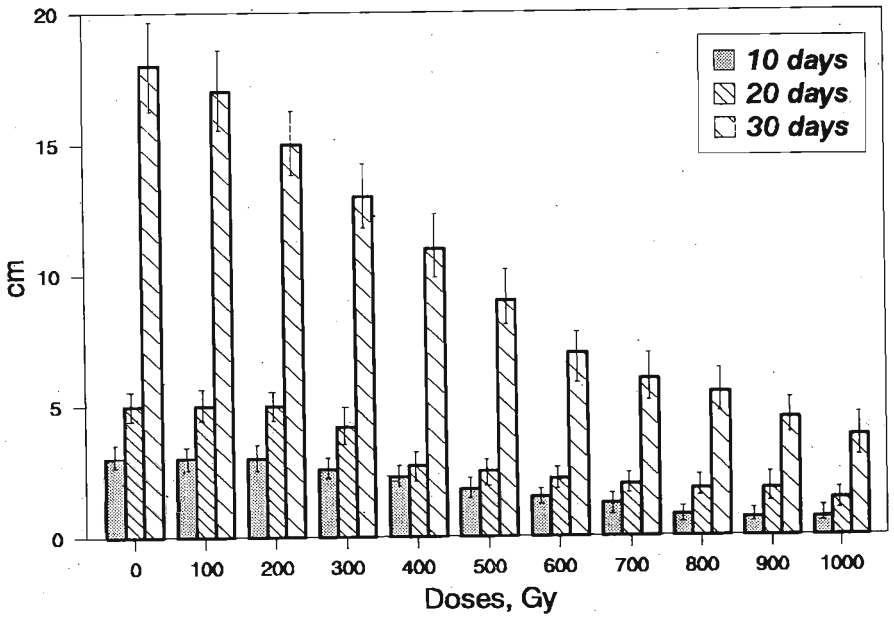

Figure 4 : Seedling height of MI2 cultivar treated with different doses of gamma rays.

The measurements taken on the 15th day produced the least coefficient of variation and the best separation into groups by the Duncan's Multiple Range Test . The results of the analysis of variance of characters studied in the uprooted seedlings (Table 1) agree with the data on plant height (Fig. 3) . As the trend in the two varieties was similar, only the data for MI3 are presented (Table 1). Fifty per cent growth reduction in root length was detected in the range 1250 -1375 Gy for MI3 and 800-900 Gy for MI2. The GR 50 values for epicotyl and hypocotyl length of both varieties were lower. For MI3 they were in the range 750-875 Gy and for MI2 the range was 500 - 700 Gy as in the case of plant height. The weight of fresh seedlings and dry weight of roots or shoots recorded less reliable results due to a higher coefficient of variation. Nevertheless, GR 50 was in the range of 750 Gy and 1000 Gy for MI3 and 500 - 700 Gy for MI2 varieties.

Table 1: Effect of gamma radiation on different characters of MI3 seedlings at 15 days[a].

Dose (GY)	Root length (cm)	Epicotyl length (cm)	Hypocotyl length (cm)	Seedling fresh weight (g)	Root dry weight (mg)	Shoot dry weight (mg)	1st leaf length (cm)
00	3.75^{a}	8.633^{a}	2.533^{a}	1.327^{a}	9.2^{a}	175.3^{a}	4.50^{a}
250	3.71^{a}	7.100^{b}	2.330^{a}	1.080^{ab}	7.6^{ab}	162.0^{ab}	4.48^{a}
500	3.60^{a}	6.417^{bc}	1.600^{b}	0.823^{bc}	7.7^{ab}	145.4^{ab}	3.33^{b}
625	3.18^{ab}	5.417^{cd}	1.400^{b}	0.700^{cd}	5.7^{bc}	123.7^{bc}	3.18^{b}
750	2.78^{bc}	4.500^{de}	1.267^{bc}	0.417^{de}	5.0^{bcde}	84.0^{cd}	3.08^{b}
875	2.51^{bcd}	3.967^{e}	0.950^{cd}	0.370^{ef}	5.6^{bcd}	83.0^{cd}	2.65^{bc}
1000	2.13^{cde}	3.487^{ef}	0.600^{de}	0.277^{ef}	2.4^{def}	57.0^{de}	2.15^{cd}
1125	2.17^{cde}	3.150^{ef}	0.567^{e}	0.237^{ef}	2.9^{cdef}	49.0^{de}	1.55^{def}
1250	2.33^{cd}	2.100^{fg}	0.433^{ef}	0.197^{ef}	4.1^{cdef}	46.4^{de}	1.75^{de}
1375	1.75^{def}	1.783^{g}	0.100^{f}	0.200^{ef}	4.0^{cdef}	44.5^{de}	1.28^{efg}
1500	1.48^{ef}	1.118^{g}	0.050^{g}	0.070^{ef}	1.7^{f}	16.9^{e}	1.00^{fg}
1750	1.13^{f}	0.773^{g}	0.050^{g}	0.052^{f}	2.2^{ef}	14.9^{e}	0.68^{g}
CV%	17.32	18.40	21.62	38.61	34.05	30.55	16.31
F value	11.94	33.4	49.56	14.88	6.31	14.18	30.44
P>F	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001

a - Values denoted by the same letter in each column are not significantly different according to the Duncan's Multiple Range Test.

The high level of tolerance of sesame seeds to irradiation when germination is considered[3] and the difference in the radiosensitivity of different sesame genotypes observed by other authors[3-6] are substantiated by the present experiment. It is clear from these results that MI3 tolerates higher doses of gamma rays than MI2. The most suitable doses of gamma-rays for seed irradiation in mutation breeding experiments using locally recommended sesame cultivars lie in the range of 750 - 1000 Gy for MI3 and 500-700 Gy for MI2.

Acknowledgement

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