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Differential Radiosensitivity of Black Pepper (*Piper nigrum* L.) Cultivars*

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Ripe, fresh seeds of six high-yielding cultivars were irradiated with 1-4 Krads of gamma rays and seed germination and seedling abnormalities were studied. Cultivars showed differential radiosensitivity with regard to germination and seedling chlorophyll abnormalities. The reduction in germination was found to be almost linear and the LD₅₀ (in terms of germination) was between 2.5 to 3.5 Kr in most of the cases.

Induction of mutations through gamma rays was resorted to in black pepper for inducing resistance/tolerance to *Phytophthora palmivora* (MF₄), the causal organism of quick wilt disease (or foot-rot) of pepper. This paper deals with the results of a study being carried out in some cultivars of pepper. Earlier some studies were carried out at Sarawak using a Malaysian cultivar (Anoi, 1975; 1981). Irulappan *et al.*, (1982) in a preliminary note reported some observations on morphological characters of irradiated rooted pepper cuttings.

MATERIALS AND METHODS

For assessing the effect and for fixing up the optimum dose, an initial irradiation trial was carried out in which freshly harvested ripe seeds of the cultivar 'Karimunda' were exposed to nine doses (1-9 krads) of gamma rays in the gamma irradiation chamber available at the Sugarcane Breeding Institute, Coimbatore. Later, ripe fresh seeds from six common cultivars were irradiated at 1, 2, 3 and 4 krads in the 'gamma-shine' unit of the Botany Department, University of Kerala, Trivandrum. In each dose one thousand seeds were irradiated and they were sown the following day in sterile soil potting mixture in seed

pans at the rate of 250 seeds per pan. Observations on germination, days to achieve 50 per cent germination (Gr 50), germination percentage and morphological abnormalities (mainly chlorophyll changes) were recorded. As fully ripe freshly harvested seeds were used for irradiation, no efforts were made to determine their moisture content.

RESULTS AND DISCUSSION

The germination data is presented in Table 1. Irradiation adversely affected germination of seeds in all the cultivars at all doses. As the dose increased, there was delay in germination; thus in Karimunda, in the control, the Gr 50 (50% germination of seeds) was reached by the 40th day, while at 3 kr it took 65 days and at 4 kr the germination was below 50 per cent. In the cultivars tested, the difference between control and 3 kr to reach Gr 50 was three days in Kalluvally (Malabar type), six days in Thommankodi, 15 days in Kuthiravally, 25 days in Karimunda and 28 days in Panniyur-I. In Kalluvally (Malabar type) all the treatments gave more than 50 per cent germination.

Of the cultivars used in the study, Kalluvally (Pulpally type) gave the

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TABLE 1. GERMINATION DATA OF GAMMA-RAY IRRADIATED SEEDS OF SEVEN PEPPER CULTIVARS

<i>Cultivar and treatment</i>	<i>No. of days to start germination</i>	<i>No. of days to 50% germination</i>	<i>No. of days to maximum germination</i>	<i>Germination %</i>	<i>% reduction in germination at each dose</i>
Karimunda					
Control	32	40	52	74.0	
1 Kr	34	49	51	60.8	17.8
2 Kr	36	44	51	62.0	16.2
3 Kr	36	65	69	53.2	28.1
4 Kr	37	—	69	35.2	52.4
Panniyur-I					
Control	31	40	62	61.6	
1 Kr	39	51	66	62.1	-0.81
2 Kr	37	—	69	49.4	19.80
3 Kr	38	69	69	50.5	18.02
4 Kr	40	—	69	46.2	25.00
Kuthiravally					
Control	32	42	52	61.0	
1 Kr	32	45	50	60.8	0.33
2 Kr	32	46	51	62.4	-2.30
3 Kr	33	47	52	58.4	4.26
4 Kr	38	—	68	38.8	36.34
Kalluvally (Pulpally)					
Control	31	—	59	32.5	
1 Kr	27	—	60	16.0	50.76
2 Kr	29	—	60	22.8	29.84
3 Kr	29	—	58	25.2	22.46
4 Kr	30	—	58	9.6	70.46
Kalluvally (Malabar Type)					
Control	32	56	70	83.0	
1 Kr	33	53	73	70.0	15.66
2 Kr	32	60	73	56.0	32.53
3 Kr	38	59	83	51.0	38.55
4 Kr	40	58	90	50.5	39.16
Thommankodi					
Control	30	33	44	60.0	
1 Kr	28	39	49	68.7	14.50
2 Kr	28	—	57	45.0	25.00
3 Kr	27	39	57	66.0	-10.00
4 Kr	28	41	56	58.4	2.67
Aimpiriyan					
Control	31	60	63	82.0	
1 Kr	28	51	60	52.5	35.97
2 Kr	27	—	42	49.0	40.24
3 Kr	30	—	61	46.0	43.90
4 Kr	30	—	61	37.5	52.27

lowest germination rate, even in the control seeds. The percentage reduction in germination from 0-4 Kr was high in the case of Aimpiriyam (52.27%), Karimunda (52.4%), Kalluvally (Malabar type; 39.16%), Kalluvally (Pulpally type; 70.46%) and low in Kuthiravally (36.34%), Panniyur-I (25.0%) and Thommankodi (2.67%). This indicates that Kalluvally (Pulpally), Karimunda and Aimpiriyam were most affected by the radiation treatment, and Thommankodi the least. When the data was considered in terms of control vs. irradiated, it was found that the most marked reduction was found in Aimpiriyam and Kalluvally (Pulpally).

The M_1 populations showed certain morphological abnormalities such as chlorophyll changes, twinning of seedlings, rosette like leaves etc. Table 2

TABLE 2.
FREQUENCY OF CHLOROPHYLL
ABNORMALITIES IN M_1 GERMINATION

Cultivar	1Kr	2Kr	3Kr	4Kr	Total	%
Karimunda	10	11	12	6	39	13.0
Panniyur-I	10	5	5	0	20	0.7
Kuthiravally	1	4	4	6	14	0.1
Kalluvally	1	0	1	1	3	0.1
Thommankodi	4	2	2	3	11	0.3
Aimpiriyam	1	3	5	0	9	0.2

gives the frequency of chlorophyll abnormalities in the M_1 seedling population. Karimunda gave the highest per cent of chlorophyll mutants (13%). In the other cultivars, the frequency was below 1 per cent. It may be mentioned that in the control population also the chlorophyll abnormalities were much higher in Karimunda (3.2%); while in the other cultivars such chlorophyll changes were virtually absent.

The major chlorophyll abnormalities were white (albino), yellow (xantha) and variegated seedlings. The albino and most of the xantha seedlings were lethal, while the variegated seedlings developed normally. Here, the variegation was found to disappear as the leaves attained maturity. Sometimes the young leaves of these variegated plants were fully white which later became variegated, characterised by white or yellow patches intermingled with green, similar to the 'Chlorotica variomaculata' type described in peas by Blixt (1961). The higher frequency of chlorophyll mutations in Karimunda may also be indicating a more homozygous nature as it is well known that in the progenies of inbred lines of crop plants such as maize, barley etc., chlorophyll mutations occur commonly (Gustafson, 1940).

In many plants the chlorophyll mutations are often taken as an index of radiation sensitivity (Gustafson, 1940; Constantin *et al.*, 1974). In black pepper, the higher number of chlorophyll changes may be indicating a greater sensitivity to radiation or a more homozygous condition, because both conditions are known to give higher percentage of chlorophyll mutations (Constantin *et al.*, 1974).

The M_1 seedlings are being screened for tolerance to *Phytophthora palmivora* (MF₄). Part of the M_1 seedlings are being carried over to M_2 generation for further screening. The results of these studies will be reported in due course.

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