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GENETIC VARIATION AND CYTOLOGICAL INSTABILITY RESULTED FROM GAMMA IRRADIATION OF TWO BREAD WHEAT CULTIVARS

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ABSTRACT

In this investigation an attempt was made to create new genetic variations with improved yield-related traits in two Egyptian bread wheat cultivars using gamma radiations; and to study the effect of gamma irradiation on mitotic activity and chromosomal aberrations, which are used as parameters for cytological instability in both mitotic and meiotic cell divisions. Irradiation doses caused different degrees of reductions in grain yield/plant and its related traits in M_1 ***of Giza 168 and Sakha 93 cultivars except for 100-kernel weight. The segregated*** M_2 ***populations of irradiated Giza 168 and Sakha 93 showed some degrees of superiority as compared with their original parents. The phenotypic coefficient of variation (PCV%) estimates were slightly higher than the genotypic coefficient of variation (GCV%) estimates for all traits under study. The GCV% and PCV% estimates in both Giza 168 and Sakha 93 were generally higher in the*** M_2 ***than*** M_1***. The studied parents and each of irradiated treatments exhibited variation ranged from the highest score of mitotic index in Giza 168 irradiated with 400GY (25.94), Sakha 93 irradiated with 350GY (20.48) and Sakha 93 treated with 400GY (20.54) to its lowest estimate (11.85 and 11.01) in the untreated control of Giza 168 and Sakha 93. The highest score of abnormalities was observed in Sakha 93 treated with 350GY, Sakha 93 irradiated with 400GY and Giza 168 irradiated with 300GY. By contrast, the lowest score of abnormalities was detected in the untreated control of Sakha 93 through the mitotic divisions. However, each irradiation treatment (250GY, 300GY, 350GY and/or 400GY) has higher percentage of cells containing chromosomal aberrations in meiosis as compared to the parental control of Giza 168 and Sakha 93 (i.e., unirradiated control).***

Key words: ***Bread wheat, Triticum aestivum, Gamma radiation, Genetic variation, Mutations, Cytology, Chromosome aberrations.***

INTRODUCTION

Wheat is a major food grain consumed by humans, and its production surpasses that of all other crops. It is the staple food of nearly 35% of the world population; its demand will continue to grow faster than that for any other major crop (Mujeeb-Kazi and Villareal 2002). Both bread wheat (*Triticaum aestivum* L.; $2n=6x=42$; A.B and D genomes and *Turgidum ssp. Durum* L.$2n=4x=28$; A and B genomes) have multiple gene characterized by regions differing in gene density and distribution (Homann *et al* 1994 and Sandhu and Gill 2002).

The existence of genetic variation for selection in crop plants is a primary prerequisite for the success in developing improved varieties. To create new genetic variations, hybridization and mutation breeding procedures followed by generating of segregating generations are frequently used. Irradiation has been previously reported as an effective tool for increased genetic variability and mutation induction in several wheat treats such as: glaucousness, spikes per plant, spikelets per spike, kernels per spike, kernel size, increased yield, reduced height, awnedness, stem and leaf rust resistance, amber grain color, earliness, closed canopy phenotype and increased grain protein (Al-Bakry 2004, Al-Naggar *et al* 2004 and Konzak 1987). More than 2,252 mutant varieties have been officially released as perviously reported in Maluszynski *et al* (2000) and Ahloowalia *et al* (2004). Many induced mutants were released either directly as new varieties or were used as parents to derive new varieties. Mutation induction with radiation was the most frequently used method to develop direct mutant varieties (89%) Ahloowalia *et al* (2004).

Irregular meiosis was observed in triticale controls (with laggards and univalents) but increased in frequency with increasing radiation dose in all species (Major and Khanna 1988). In this respect, Arora *et al* (1989) reported that mitotic aberrations in the root tips, anaphase bridges and micronuclei at telophase were increasing by gamma irradiation.

The first and main objective of the present investigation was to induce genetic variations for the purpose of selecting desirable variants characterized with improved yield-related traits in two Egyptian bread wheat cultivars using gamma radiations. The second objective was to obtain the following cytogenetical information:

1. Determining of mitotic cell divisions in parents and irradiated treatments.
2. Determining frequency of micronuclei and chromosomal aberrations in mitotic and meiotic cell division as an indication of the cytological instability in parents and irradiated treatments.

MATERIALS AND METHODS

Materials

Kernels of two bread wheat cultivars, viz. Giza 168 and Sakha 93, were used in this study as parents. They were obtained from Wheat Research Section, Field Crops Research Institute, Agricultural Research Center (ARC), Giza, Egypt.

Fresh air-dried seeds with 12% moisture content from each of the two wheat cultivars used in the present study were treated with four different doses of gamma rays i.e. 250, 300, 350, and 400 GY, in addition to the untreated control (0 GY). Irradiation treatments were achieved by a Co-

60 (Cobalt-60) Gamma Irradiation Unit, Cyclotron Project, Nuclear Research Center, Atomic Energy Authority, Egypt.

Field experiments

Season 2008 / 2009

The irradiated and non-irradiated kernels of each wheat cultivar were planted in the field on the 17th of November 2008, at the experimental fields of Plant Research Dept., Nuclear Research center, Anshas, Al-Sharkia Governorate under full irrigation regime (surface irrigation every ten days). Individual seeds were planted in 2.0-meter rows, at 10-cm space between plants and 30 cm between rows in blocks. Each block contains 50 rows i.e. 10 rows for each treatment. The experimental design was a randomized complete block design (RCBD) with three replications.

Season 2009 / 2010

In 2009/2010 season the main spike of 20 M_1 plants from each treatment were selected to develop M_2 plants. Spike selection was based on the changes in spike and plant morphology. These morphological changes included spike type, glume shape, grain size, and plant height. Sixty individual kernels from each selected spike were planted in 2.0-meter rows in blocks with three replications, at 10-cm space between plants and 30 cm between rows. These experiments were conducted at the same experimental farm under the same irrigation regimes, viz. irrigation every ten days in a RCBD.

Data recorded

In both seasons (2008/2009 and 2009/2010) data were recorded on grain yield/plant (g), number of fertile spikes/plant, number of spikelets/spike, number of kernels/spike and 100-kernel weight (g). Sixty guarded plants from each treatment were used for data recording both in M_1 and M_2.

Normal analysis of variance of the data was performed according to Gomez and Gomez (1984).

Phenotypic (PCV) and genotypic (GCV) coefficients of variation for the studied characters were calculated as described by Burton and De-Vane (1953) and Johnson *et al* (1955) using the following formula:

Data analysis

$PCV = (\delta ph / \overline{X}) . 100$

$GCV = (\delta g / X) . 100$

Where: X is the general mean, δph and δg are the phenotypic and genotypic standard deviations in the same rank and they estimated according to the following formula:

δph = square root of $(\delta^2 g + (\delta^2 e / r))$
δg = square root of $(MSg - MSe) / r$
Where: MSg and MSe are the mean square of genotypes and error, respectively.

Cytological studies

For mitotic studies, 45 grains from each of the two parents (without treatment) and from each treatment (250,300,350 and 400 GY) were germinated on moist filter paper on Petri dishes at room temperature in a randomized complete block design experiment with three replications. Each replication comprised three dishes for each entry and each dish contained 15 grains. Actively growing root-tips were cut from the seedlings and fixed in Farmer solution. The Aceto-carmine squash technique was used to stain the root-tip cells as described by Sayed Ahmed (1985). Nine prepared slides were used for each parent and each treatment to determine the frequencies of mitotic index and chromosomal aberrations.

For studying meiosis and chromosomal aberration, whole spikes of the parents and each treated plants were collected at an appropriate stage, immediately fixed in a 3:1 alcohol/acetic acid solution for 24 hours. Then they were washed with distilled water several times before being stored in 70% ethanol. Squash preparations pollen mother cells (PMCs) were made in Aceto-carmine as described by (Fayed et al 1984). About 20 slides were prepared from 10 randomly selected plants for each parent or each treatment. The prepared slides were used to determine micronuclei and chromosomal aberrations in meiotic cells.

All data were statistically analyzed according to Snedecor and Cochran (1982).

RESULTS AND DISCUSSION

Analysis of variance

Data on analyses of variance of the experiments conducted in 2008/2009 season (Table 1) indicated that mean squares due to irradiated Giza 168 and Sakha 93 in the M_1 generation were significant or highly significant for all studied traits except for spikelets/spike in Giza 168 and 100-kernel weight in Sakha 93.

Data on analyses of variance of (Table 2) indicated significant and/or highly significant M_2 generation mean squares due to irradiated Giza 168 and Sakha 93 for all studied traits.

Table 1. Mean squares for grain yield/plant and its related traits in M_1 of both Giza 168 and Sakha 93 cultivars as affected by gamma-ray doses.

S.O.V.	d.f.	Giza 168					Sakha 93				
		Grain yield/plant	Spikes /plant	Spikelets /spike	Kernels /spike	100-kernel weight	Grain yield/plant	Spikes /plant	Spikelets /spike	Kernels /spike	100-kernel weight
Replications	2	12.09	1.73	0.31	3.55	0.01	0.17	1.32	13.56	26.38	0.02
Irradiated Populations	4	49.68*	2.82*	0.32^{NS}	28.96*	0.03*	1.43*	3.66**	27.34*	64.10**	0.03^{NS}
Error	8	5.36	0.66	0.21	4.93	0.01	0.36	0.44	7.74	5.11	0.02

*, ** : indicate significance at 0.05 and 0.01 levels of probability, respectively.
ns: indicates no significance.

Table 2. Mean squares for grain yield/plant and its related traits in M_2 of both Giza 168 and Sakha 93 cultivars as affected by gamma-ray doses.

S.O.V.	d.f.	Giza 168					Sakha 93				
		Grain yield/plant	Spikes /plant	Spikelets /spike	Kernels /spike	100-kernel weight	Grain yield/plant	Spikes /plant	Spikelets /spike	Kernels /spike	100-kernel weight
Replications	2	1.16	0.01	13.64	43.46	0.02	0.74	0.58	4.14	1.11	0.08
Irradiated Populations	4	6.65*	2.98**	104.86**	95.54**	1.04**	3.71**	8.13**	127.28**	314.53**	0.47**
Error	8	1.41	0.27	12.84	74.71	0.02	0.44	0.61	2.83	3.02	0.02

*, ** : indicate significance at 0.05 and 0.01 levels of probability, respectively.
ns: indicates no significance.

Mean Performance

Mean performance for grain yield and its related traits in M_1 populations of Giza 168 and Sakha 93 cultivars as affected by gamma-ray doses is presented in Table (3).

Irradiation doses caused different degrees of reductions in grain yield/plant and its related traits in M_1 of Giza 168 and Sakha 93 cultivars except for 100-kernel weight. The reduction ranged from 2.46% - 26.09% in grain yield/plant, 1.74% - 20.02% in number of spikes/plant, 1.48% - 3.72 in number of spikelets/spike, and 0.44% – 8.49 % in number of kernels/spike in irradiated Giza 168 cultivar. In Sakha 93, the reduction ranged from 0.13% - 19.12% in grain yield/plant, 4.77% - 14.65% in number of spikes/plant, 4.54% - 13.04% in number of spikelets/spike, and 4.45% - 17.35% in number of kernels/spike.

However, 100-kernel weight was increased by 4.94%, 6.59%, 3.29%, and 4.94% in Giza 168, and by 1.51%, 0.21%, 3.02%, and 5.39% in Sakha 93 as a result of irradiation with 250, 300, 350 and 400 Gy, respectively.

Table 3. Means for grain yield/plant and its related traits in M_1 of both Giza 168 and Sakha 93 cultivars as affected by gamma-ray doses.

Irradiation dose	Giza 168					Sakha 93				
	Grain yield/plant	Spikes /plant	Spikelets /spike	Kernels /spike	100-kernel weight	Grain yield/plant	Spikes /plant	Spikelets /spike	Kernels /spike	100-kernel weight
0 GY	12.04a	22.33a	37.86a	75.16a	4.25b	12.04a	22.33a	37.86a	75.16a	4.25b
250 GY	11.49a	22.00a	36.88a	71.20ab	4.46a	11.49a	22.00a	36.88a	71.20ab	4.46a
300 GY	11.66a	22.00a	36.93a	68.78b	4.53a	11.66a	22.00a	36.93a	68.78b	4.53a
350 GY	9.63b	21.50a	27.98b	68.86b	4.39ab	9.63b	21.50a	27.98b	68.86b	4.39ab
400 GY	11.83a	21.67a	36.33a	74.83a	4.46a	11.83a	21.67a	36.33a	74.83a	4.46a

Values with the same letter are not significantly different

Data on mean performance for grain yield and its related traits in M_2 segregated populations of Giza 168 and Sakha 93 are presented in Table (4). The segregated M_2 populations of irradiated Giza 168 showed some degrees of superiority as compared with its original parent. The irradiated population with 400 GY showed the highest mean performance for grain yield/plant and its related traits. The irradiated population with 350 GY showed high mean performance for grain yield/plant, number of kernels/spike, and 100-kernel weight. The irradiated population with 300 GY showed the highest mean performance for 100-kernel weight.

The segregated M_2 populations of irradiated Sakha 93 also showed some degrees of superiority as compared with its original parent. The irradiated population with 400 GY showed the highest mean performance for grain yield/plant, number of spikes/plant, number of spikelets/spike, and number of kernels/spike. The irradiated population with 350 GY showed high mean performance for grain yield/plant, number of spikelets/spike, number of kernels/spike, and 100-kernel weight.

Table 4. Means for grain yield/plant and its related traits in M_2 of both Giza 168 and Sakha 93 cultivars as affected by gamma-ray doses.

Irradiation dose	Giza 168					Sakha 93				
	Grain yield/plant	Spikes /plant	Spikelets /spike	Kernels /spike	100-kernel weight	Grain yield/plant	Spikes /plant	Spikelets /spike	Kernels /spike	100-kernel weight
0 GY	12.05a	22.93ab	38.10bc	78.62b	4.37d	10.52ab	22.00b	33.28c	64.65b	4.58b
250 GY	10.29ab	22.00b	34.35c	73.05c	4.45cd	9.62bc	22.00b	31.33c	63.22b	4.46b
300 GY	8.62b	20.54c	33.57c	70.46c	5.83a	8.96c	19.61c	25.41d	62.29b	4.58b
350 GY	10.99a	22.05ab	41.98ab	82.03a	4.67bc	8.87c	23.63a	38.45b	81.23a	5.39a
400 GY	12.51a	23.01a	47.90a	83.52a	4.71b	11.49a	23.62a	42.28a	82.76a	4.45b

Values with the same letter are not significantly different

The reduction in grain yield/plant in M_1 of both Giza 168 and Sakha 93 was due to the reduction in number of spikes/plant and number of kernels/spike; whereas, the reduction in number of kernels/spike was due to the reduction in number of spikelets/spike. However, the increase in kernel weight was due to the reduction in number of kernels/spike.

Al-Bakry (2004) and Al-Naggar *et al* (2004) carried out studies to create genetic variation in Egyptian wheat (*Triticum aestivum L.*) cultivars via gamma irradiation in M_1 and M_2 generations. It was found that irradiation caused a decrease in grain yield and most studied traits. However, a glaucous wheat mutant (GWM) was selected from irradiated Sids 1 with 300 GY in the M_1.

Al-Bakry (2007) conducted a study to characterize five new glaucous wheat mutant lines selected from the original glaucous mutant in terms of different agronomic traits and to estimate the variability in these desirable traits and compare them with their parent. Significant differences were observed among the six wheat genotypes for agronomic traits. The 1st mutant line (GWM1) is characterized by a reduced plant height (82.3 cm). The 2nd mutant line (GWM2) is early flowering mutant (60.0 days) and has heavy 100-grain weight (60.5 gm). The 3rd mutant line (GWM3) is characterized by a high number of spikes per plant, a high number of spikelets per spike and high grain yield per plant. The 4th mutant line (GWM4) has also high number of spikelets per spike and a high number of grains per spike. The 5th mutant line (GWM5) is characterized by a high number of spikes per plant and high grain yield per plant.

Coefficients of variation

The estimates of genotypic (GCV%) and phenotypic (PCV%) coefficients of variation were calculated (Table 5) to study the efficiency of irradiation in increasing variability that can help wheat breeder in the improvement process *via* selection for yield related traits.

Genotypic and phenotypic coefficients of variation in M_1 generation of Giza 168 exhibited the highest estimates in grain yield/plant followed by spikes/plant, while the lowest estimate was for number of spikelets/spike. In M_2 generation of Giza 168, the highest estimates were exhibited by grain yield/plant, number of spikes/plant and 100-kernel weight, respectively.

In Sakha 93, genotypic and phenotypic coefficients of variation in M_1 generation exhibited the highest estimates in grain yield/plant, number of kernels/spike, number of spikes/plant and number of spikelets/spike, while 100-kernel weight exhibited the lowest estimate. In M_2 generation of Sakha 93, the highest estimates were exhibited by grain yield/plant, number of kernels/spike, number of spikes/plant, 100-kernel weight and number of spikelets/spike, respectively. In this study, the phenotypic coefficient of variation (PCV%) estimates were slightly higher than the genotypic coefficient of variation (GCV%) estimates for all traits under study. In addition, it is worthy to note that the GCV% and PCV% estimates in both Giza 168 and Sakha 93 were generally higher in the M_2 than M_1.

Table 5. Genotypic and phenotypic coefficients of variability (GCV% and PCV%) for grain yield/plant and its related traits in M_1 and M_2 of both Giza 168 and Sakha 93 cultivars as affected by gamma-ray doses.

Coefficient of variability	Giza 168					Sakha 93				
	Grain yield/plant	Spikes /plant	Spikelets /spike	Kernels /spike	100-kernel weight	Grain yield/plant	Spikes /plant	Spikelets /spike	Kernels /spike	100-kernel weight
	M_1					M_1				
GCV%	7.49	0.91	10.92	3.94	1.89	5.70	5.01	8.31	7.26	1.34
PCV%	8.56	1.48	11.56	4.33	2.37	6.58	5.36	9.81	7.57	2.11
	M_2					M_2				
GCV%	12.19	4.29	14.14	3.39	12.12	10.56	7.15	18.86	14.39	8.26
PCV%	13.73	4.50	15.09	7.28	12.30	11.26	7.43	19.07	14.46	8.53

In the study conducted by Al-Bakry (2007) on the glaucous wheat mutant lines, the phenotypic coefficient of variation (PCV %) estimates were slightly higher than the genotypic coefficient of variation (GCV %) estimates for all traits under study. The highest estimates of PCV% and GCV% were shown by number of spikes per plant and number of grains per spike. However, grain yield per plant exhibited moderate PCV% and GCV% estimates.

In general, biometrical analyses of variation have shown that the increase in phenotypic variation in generations following irradiation, particularly in self-pollinated plants, is due mainly to an increase in the genetic component, and it may be accounted for by the effects of mutations on the genetic factors influencing quantitative characters. From a plant breeding point of view this is an important effect because larger genetic variation means the possibility of larger responses to selection and higher chances for improvement (Scossiroli, 1977).

It could be concluded from these results that irradiation causes an increase in the magnitudes of GCV% for grain yield and its related traits. This might be attributed to the creation of new genetic variation *via* irradiation, which can help in increasing the efficiency of selection for yield and yield-related traits.

Mitotic activity

The data of mitotic activity, expressed by the mitotic index (M.I), in parents Giza 168 and Sakha 93 cultivars as affected by gamma ray doses are presented in Table (6). This table showed variation in MI between each of the irradiation treatments and unirradiated control of Giza 168 and Sakha 93. This variation ranged from the highest score of MI in Giza 168 irradiated with 400 GY (25.94), Sakha 93 irradiated with 400 GY (20.54) and Sakha irradiated with 350 GY (20.48) to its lowest estimate (11.85 and 11.01) in the control untreated of Giza 168 and Sakha 93. Mitotic index in Giza 168 irradiated with 250 GY and 350 GY and Sakha 93 irradiated with

250 GY was close to the highest score found in Giza 168 irradiated with 300 GY.

The high MI in Giza 168 and Sakha 93 irradiated with 400 GY, Sakha 93 irradiated with 350 GY and Giza 168 irradiated with 300 GY, probably, indicated that these lines could be more adapted to the Egyptian conditions than the 300GY treatment and the control treatment for Sakha 93 in which MI was sharply reduced. In this respect, Borzouela *et al* (2010) studied effects of gamma radiation on germination and physiological characteristics of wheat seedlings of two wheat genotypes irradiated with 100, 200, 300 and 400 GY. The results showed that mean germination time root and shoot length and seedling dry weight decreased with increasing radiation doses.

The decrease in MI could be attributed to the increase in length of interphase period (Dulout and Olivero 1984). The frequencies of interphase observed in the lines which showed low MI in the present study were obviously higher than of high MI, indicating the effect of gamma irradiation of prolonged interphase as suggested by the above authors.

Table 6. Mitotic index (M.I) and frequency of mitotic phases in M_2 of both Giza 168 and Sakha 93 cultivars as affected by gamma-ray doses.

Parent and irradiation dose	Total no. of studied cells	Total no. of divided cells	M.I	Frequency of mitotic phases		
				Prophase	Metaphase	Ana-Telophase
Giza 168(0GY)	1578	187	11.85	7.67	1.65	2.53
Giza 168(250GY)	1863	313	16.80	11.22	2.15	3.43
Giza 168(300GY)	1591	277	17.41	11.82	2.07	3.52
Giza 168(350GY)	1672	272	16.27	10.71	2.63	2.93
Giza 168(400GY)	1870	485	25.94	15.40	3.32	3.48
Sakha 93(0GY)	1499	165	11.01	7.47	1.40	2.13
Sakha 93(250GY)	1525	245	16.07	11.74	1.57	2.30
Sakha 93(300GY)	1699	236	13.89	9.77	1.65	2.47
Sakha 93(350GY)	1606	329	20.48	13.01	2.93	2.80
Sakha 93(400GY)	1456	299	20.54	13.39	2.54	2.20

Chromosomal aberrations in mitotic and meiotic cells

The data presented in Tables (7 and 8) showed that the percentage of cells containing either micronuclei or chromosomal aberrations in mitotic and meiotic divisions depended on each irradiation treatment. These differences ranged from the highest score of abnormalities in Sakha 93 irradiated with 350 GY and 400 GY and Giza 168 irradiated with 300 GY to the lowest estimate in unirradiated control of Sakha 93 in mitotic divisions. However, Giza 168 irradiated with 250 GY, 350 GY and 400 GY and Sakha 93 irradiated with 300 GY exhibited higher frequencies of abnormalities than the unirradiated control of Giza 168 and Sakha 93 treated with 250 GY. Table (8) also showed that each irradiation treatment (250 GY, 300 GY, 350 GY and 400 GY) have higher percentage of cells containing chromosomal aberrations in meiosis than the control of Giza 168 and Sakha 93.

The increased frequency of chromosomal aberrations in most irradiation treatments indicated the role of gamma irradiation for the occurring of chromosomal aberrations as reported by Uppal and Maherchandani (1988). In this respect, Khalaf *et al* (2007) observed increased frequency of micronuclei and chromosomal aberrations in mitotic and meiotic cell divisions of wheat with increasing radiation doses. Xie *et al* (1994) found chromosomal aberrations in both un-irradiated and irradiated protoplasts, but irradiation apparently increased the frequency of chromosomal aberrations.

The types of micronuclei compact and non-compact, previously described by Hasseman and Fayed (1982) in *Vicia faba* were also detected in mitotic and meiotic of the parents and each irradiation dose. The various types of chromosomal aberrations were presented in Tables (7 and 8). The types observed in mitotic division were stickiness, fragments, laggards and binucleate cells. In meiosis the observed types included stickiness, fragments, laggards and unequal distribution of chromosomes. i.e. anaphase II or telophase II revealed only three nuclei (Figure 1). Binucleate cells and stickiness represented the most frequent types of chromosomal aberrations in mitosis and meiosis of the studied materials. The other kinds of aberrations were present but in low frequencies.

The results regarding the differences in mitotic index between the parents and irradiation doses are given in table (9). The data of this table showed significant differences in mitotic index between the parents and irradiation doses which suggested that differences in mitotic index could be attributed to the effect of gamma radiations on the studied lines. From Table (9) it was obvious that significant differences could be seen in number of cells containing chromosomal aberrations between the parents and irradiation doses in mitotic and meiosis in many cases.

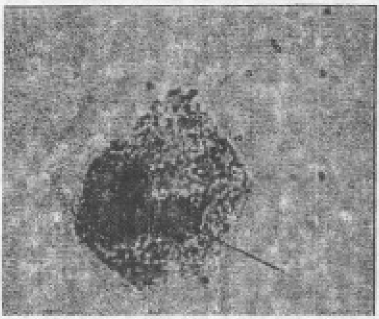

Fig a: compact micronuclei

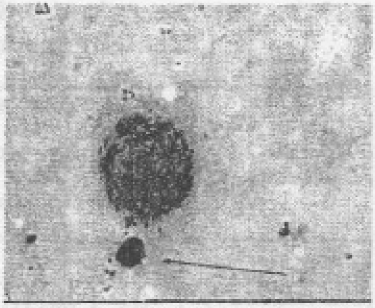

Fig b: non compact micronuclei

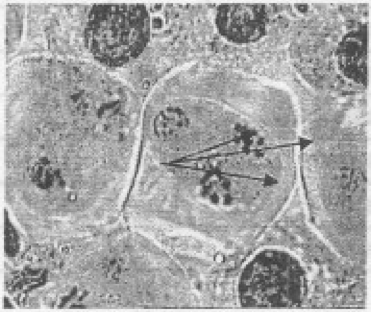

Fig c: unequal distribution of chromosomes

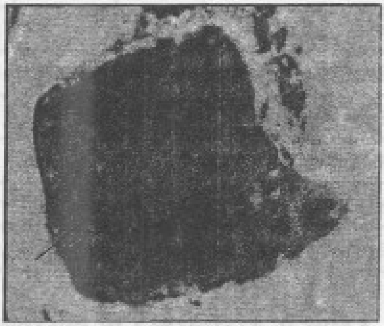

Fig d: a laggard chromosome

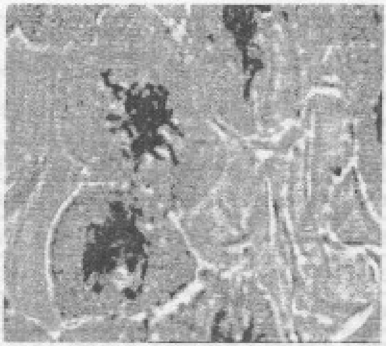

Fig e: chromosomal stickiness

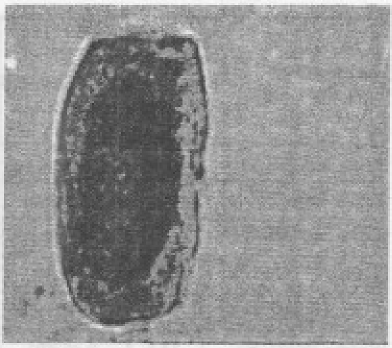

Fig f: binucleate cells

Figs. 1. (a : f): types of micronuclei and chromosomal aberrations.

Table 7. Frequency of micronuclei and chromosomal aberrations in M_2 meristematic root-tips of both Giza 168 and Sakha 93 cultivars as affected by gamma-ray doses.

Parent and irradiation dose	Total divided cells	Percentage of chromosomal aberrations (%)	Percentage of types of micronuclei		Percentages of the main types of chromosomal aberrations			
			Compact	Non-compact	Fragment	Stickiness	Binucleate cells	Laggard
Giza 168(0GY)	187	6(3.11)	1(0.53)	1(0.53)	0(0.00)	2(1.07)	4(2.14)	0(0.00)
Giza 168(250GY)	313	16(5.11)	1(0.32)	1(0.32)	1(0.32)	5(1.60)	7(2.23)	1(0.32)
Giza 168(300GY)	277	19(6.86)	4(1.44)	4(1.44)	1(0.36)	2(0.72)	7(2.52)	1(0.36)
Giza 168(350GY)	272	18(6.62)	1(0.37)	2(0.72)	4(1.47)	4(1.47)	6(2.21)	1(0.37)
Giza 168(400GY)	485	24(4.95)	3(0.62)	3(0.62)	3(0.62)	7(1.44)	5(1.03)	3(0.62)
Sakha 93(0GY)	165	0(0.00)	0(0.00)	0(0.00)	0(0.00)	0(0.00)	0(0.00)	0(0.00)
Sakha 93(250GY)	245	7(2.86)	1(0.41)	2(0.82)	0(0.00)	2(0.82)	1(0.41)	1(0.41)
Sakha 93(300GY)	236	15(6.36)	3(1.27)	3(1.27)	1(0.42)	3(1.27)	2(0.85)	3(1.27)
Sakha 93(350GY)	329	34(10.33)	7(2.13)	4(1.22)	5(1.52)	7(2.13)	8(2.43)	3(0.91)
Sakha 93(400GY)	299	30(10.03)	5(1.67)	3(1.00)	5(1.67)	6(2.01)	7(2.43)	4(1.34)

Table 8. Frequency of micronuclei and chromosomal aberrations in M_2 pollen mother cells of both Giza 168 and Sakha 93 cultivars as affected by gamma-ray doses.

Parent and irradiation dose	Total divided cells	Percentage of chromosomal aberrations (%)	Percentage of types of micronuclei		Percentages of the main types of chromosomal aberrations			
			Compact	Non-compact	Fragment	Stickiness	Binucleate cells	Laggard
Giza 168(0GY)	317	5 (1.58)	2 (0.63)	2 (0.63)	0 (0.00)	1 (0.32)	0 (0.00)	0 (0.00)
Giza 168(250GY)	299	11 (3.68)	2 (0.67)	2 (0.67)	0 (0.00)	3 (1.00)	1 (0.33)	3 (1.00)
Giza 168(300GY)	327	14 (4.28)	2 (0.61)	3 (0.93)	1 (0.31)	3 (0.93)	3 (0.93)	2 (0.61)
Giza 168(350GY)	261	11 (4.21)	3 (1.15)	1 (0.38)	0 (0.00)	4 (1.53)	0 (0.00)	3 (1.15)
Giza 168(400GY)	316	16 (5.06)	2 (0.63)	2 (0.63)	2 (0.63)	4 (1.27)	3 (0.95)	3 (0.95)
Sakha 93(0GY)	214	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)
Sakha 93(250GY)	268	7 (2.61)	2 (0.75)	1 (0.37)	0 (0.00)	2 (0.75)	0 (0.00)	2 (0.75)
Sakha 93(300GY)	321	13 (4.05)	3 (0.93)	1 (0.31)	2 (0.62)	3 (0.93)	1 (0.31)	3 (0.93)
Sakha 93(350GY)	465	14 (3.01)	1 (0.21)	3 (0.64)	2 (0.43)	3 (0.64)	2 (0.43)	3 (1.64)
Sakha 93(400GY)	464	20 (4.31)	4 (0.86)	2 (0.43)	3 (0.65)	5 (1.07)	2 (0.43)	4 (0.86)

Table 9. Significance of the total number of mitotic index and chromosomal aberrations in mitotic and meiotic divisions in M_2 of both Giza 168 and Sakha 93 cultivars as affected by gamma-ray doses.

Parent and irradiation dose	Mitotic index	Chromosomal aberrations in mitotic division	Chromosomal aberrations in meiotic division
Giza 168(0GY)	11.85 ^{E}	3.21 ^{H}	1.58 ^{H}
Giza 168(250GY)	16.80 ^{C}	5.11 ^{F}	3.68 ^{E}
Giza 168(300GY)	17.41 ^{C}	6.86 ^{C}	4.28 ^{B}
Giza 168(350GY)	16.27 ^{C}	6.62 ^{D}	4.21 ^{C}
Giza 168(400GY)	25.94 ^{A}	4.95 ^{G}	5.06 ^{A}
Sakha 93(0GY)	11.01 ^{E}	0.00 ^{J}	0.00 ^{I}
Sakha 93(250GY)	16.07 ^{C}	2.86 ^{I}	2.61 ^{G}
Sakha 93(300GY)	13.89 ^{D}	6.36 ^{E}	4.05 ^{D}
Sakha 93(350GY)	20.48 ^{B}	10.33 ^{A}	30.01 ^{F}
Sakha 93(400GY)	20.54 ^{B}	10.03 ^{B}	4.31 ^{B}

L.S.D at 0.05 % mitotic index: 1.70 Chromosomal aberration in mitotic division: 0.053 Chromosomal aberration in meiotic division: 0.538

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التباين الوراثى وعدم الثبات السيتولوجى الناتجين عن تشعيع صنفين من قمح الخبز بأشعةجاما

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أجري هذا البحث بهدف استحداث ودراسة تباينات وراثية جديدة فى صفات المحصول ومكوناته باستخدام جرعات اشعاعية مختلفة من اشعاعات جاما فى صنفين من قمح الخبز، وأيضا لالقاء الضوء على تأثيراشعاعات جاما على النشاط الميتوزى وكذلك الانحرافات الكروموسومية داخل الانقسام الميتوزى والميوزى، وتبين من النتائج أن الجرعات الاشعاعية أدت الى استحداث تباينات فى الصفات المكونة للمحصول ظهرت فى انعزالات الجيل الثانى فى كل من الصنفين جيزة ١٦٨ وسخا ٩٣، وكذلك أدت الى ارتفاع معامل التباين الوراثى للصفات المدروسة، لوحظ وجود تباين واضح فى نسبة الانقسام الميتوزى بين الأباء (المقارنة) والجرعات الاشعاعية المختلفة حيث أظهرت النتائج أن صنف جيزة ١٦٨ المعامل بالجرعة ٤٠٠ جراى، وصنف سخا ٩٣ المعامل بالجرعتين ٣٥٠ جراى و ٤٠٠ جراى أظهروا أعلى نسبة فى الانقسام الميتوزى حيث سجلوا نسب ٢٥.٩٤%، ٢٠.٤٨%، ٢٠.٥٤% على التوالى، فى حين أظهرت الأباء (المقارنة) أقل نسبة ١١.٠١% و ١١.٨٥% على التوالى، كما أظهرت النتائج وجود تباين فى نسبة الانحرافات الكروموسومية بين الأباء (المقارنة) والمعاملات الاشعاعية المختلفة ويمكن القول أن الانعزالات ذات النشاط الميتوزى يمكن أن تستخدم فى برامج التربية حيث أنها تكون ذات أقلمة عالية لظروف البيئة وتحمل الظروف البيئية المعاكسة.