MITOTIC BEHAVIOUR INDUCED BY GAMMA RADIATION AND ITS REFLECTION ON THE VEGETATIVE AND FRUIT TRAITS OF THE SWEET MELON CV. KAHERA 6.

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amma rays are known as a type of electromagnetical ionizing radiation, which has a harmful effect on different biological system (Brunner, 1995). The radiation may affect directly cellular components, molecules and/or indirectly by causing water derived radicals. After very short time, these radicals effect on the nearby molecules by making chemical bonds breakage (Ahirwar and Verma, 2015). Exposition of cell to radiation or chemicals carcinogens may lead to DNA breaks as well as, those broken ends may rejoin in various patterns from its original arrangement, it visualized at mitotic cells division. Radiation has been extensively utilized for many years to induce mutations and chromosomal damage in many crop plants such as pearl millet (Kumar and Singh, 2003), soybean (Kumar and Rai, 2006), *Allium cepa* (Ahirwar, 2013) and sweet melon (Kahera-6 cv.) (Ali, 1995). Sweet melon (*Cucumis melo var. Aegyptiacus* L.) is considered one of the famous vegetable crops which grown in Egypt. Its fruits are consumed in the summer period and their pulp is very refreshing, high nutritional and sweet with a pleasant aroma (de Melo *et al.,* 2000). Melon is a diploid plant (2n = 2x = 24). It belongs to the Cucurbitaceae family, which also includes cucumber (*Cucumis sativus* L.), watermelon (*Citrullus lanatus* Thunb.) and squash (*Cucurbita* spp.). The commercially cultivars of sweet melon are Kahera-6, Ananas El-Dokki and Shahd El-Dokki. So, developing local sweet melon, based on local genotypes, may result in very promising outputs, because the germplasm of sweet melon available in Egypt has high genetic variability (El-Shimi and Ghoneim, 2006). On the other hand, Kahera-6 is an old cultivar and increasing its genetic variability is our target.

This investigation aimed to determine the effect of various doses of gamma rays on mitotic behavior of sweet melon cv. Kahera-6 cells as well as its expected reflection on growth and fruit characters in two successive seasons.

MATERIALS AND METHODS

Plant material

Seeds of the local cultivar of sweet melon (Kahera-6) have been obtained from Dept. of Cross Pollinated Vegetable Crops Research, Horticulture Research Institute, Agricultural Research Center (ARC), Giza, Egypt.

Gamma irradiation

Healthy dry seeds were irradiated with various doses of gamma radiation (100, 200, 300, 400 and 500 Gy). The irradiation process was carried out in National Center for Radiation and Technology (NCRRT) using ^{60}Co radiation apparatus as source of gamma rays. The first irradiated generation (M1) of Kahera-6 seeds was used in both seasons.

Field study

It was carried out during the two summer seasons of 2017-2018 and 2018-2019 at the farm of Sids experimental station, Agriculture Research Center (ARC), Egypt. Randomized complete block design with three replications have been used in this experiment and treatments were distributed randomly in plots within plot distance 50 cm. Each plot contained three rows of 4 m length and 1.5 m width. Agricultural practices were applied according to the recommendations of Ministry of Agriculture for melon production.

The following traits were determined as follows:

Emergence % was calculated for the different treatments

$$E.P = \frac{Number\ of\ emerged\ plants}{\text{Total number of planted seeds}}\ X\ 100$$

Plant height (cm)

It had been recorded in two different times (after 30 days from planting and at the end of vegetable stage approximately 100 days from planting) by measuring the distance of the stems at the ground plants.

Number of branches

Number of primary branches on the main stem was counted at the end of growing season.

Number of leaves after 30 days from planting

Number of leaves on each individual plant was counted after 30 days from planting.

Leaf width and leaf length (cm)

These two traits were measured for the fourth leaf on the main stem from the soil surface using a ruler.

Whole plant fresh weight

Whole fresh plants for all treatments were weighted (in Kg) after harvesting and their average were used for statistical analysis.

Number of fruits/plant.

The total number of fruits from each plant was recorded.

Weight of fruits per plant (Kg)

The total weight of harvested fruits was determined.

Fruit flesh thickness (cm)

The second mature fruits resulted from each treatment were cut cross wise into equal parts for measuring flesh thickness by ruler (Merghany, 1989).

Fruit length, fruit width, fruit diameter, cavity diameter, and rind thickness were measured for all fruits under all treatments by using ruler.

Total soluble solids (T.S.S %)

It was measured by using hand refractometer.

Cytological studies

This study was carried out at Cytogenetics lab., Genetics Dept., Fac. Agri., Minia Uni., El Minia governorate. Irradiated and un-irradiated seeds (control) were germinated in Petri dishes containing two layers of moist filter paper at room temperature for 48 hours. Roots with 1-2 cm in length were cut and fixed in freshly prepared farmer's fixative solution (absolute ethyl alcohol: glacial acetic acid, 3:1 v/v) for 24 hours. Fixed roots were kept in 70% ethyl alcohol in the refrigerator until use. Treated roots were washed with distilled water, hydrolyzed in 1 N HCl at 60 ^{o}C for 10 minutes, then washed by distilled water. The aceto-carmine squash preparation was used for mitotic studies. At least 2000 cells were examined for each treatment (consisting of ten seeds). Photographs were taken wherever necessary using Olympus BX51 microscope with a C-4040 zoom digital camera. Mitotic index, phase index and chromosomal aberrations were recorded in each treatment and mitotic index was calculated using the following formula as described by Racuciu (2009):

$$\text{Mitotic index} = \frac{\text{Total number of divided cells}}{\text{Total number of examined cells}} \times 100$$

Percentage of abnormality of each stage of mitosis was counted for each slide.

$$\text{Percentage of abnormality} = \frac{\text{Total number of abnormal cells}}{\text{Total number of examined cells}} \times 100$$

Vegetative and Cytological data were statistically analysis using MSTAT program (Version 4) according to Gomes and Gomes (1984).

RESULTS AND DISCUSSION

Field studies

Emergence %

The percentages of seeds emergence were shown in Fig (1). In general, the results showed that 500Gy treatment gave the lowest value (30%) while the highest values of emergence percentage were given by the control (0), 100 and 200 Gy treatments. Many various experiments, reported that the percentages of seeds germination increased, decreased, or remain unchanged after irradiation by gamma rays (Borzouei *et al.,* 2010; Hegazi and Hemeldeldin, 2010; Zanzibar and Sudrajat, 2016). These effects may be attributed to the activation of RNA or protein synthesis process (Kuzin *et al.,* 1975; 1976). This could be due to the enhanced rate of respiration or auxin metabolism in seedlings. The failure of seeds germination under higher doses of gamma rays has been attributed to several reasons such as: (i) numerous histological and cytological alterations; (ii) disruption and disorganisation of the tunica or seed layer that is directly proportional to the intensity of exposure to gamma rays; (iii) impaired mitosis or virtual elimination of cell division in the meristematic zones during germination (Lokesha *et al.,* 1992). Moreover, the inhibition of seeds emergence percentages by irradiation has often been due to the formation of free radicals in irradiated seeds (Kumagai *et al.,* 2000; Kovács and Keresztes, 2002).

Vegetative parameters

Some vegetative parameters (Fig. 2 and Table 1) showed that plants treated with different doses of gamma rays exhibited variable values for all tested vegetative traits compared to the control (0 Gy). Treatment with 300 Gy gave the highest values with a significant increase in plant height after 30 days and at harvesting stage through the two seasons (32.92cm and 204.30cm in the first season, while it was 38.53cm and 316.00cm, respectively, in the second season) compared with the control and all other treatments.

On the other side, there was a significant increase in number of leaves per plant after 30 days at all treated plants except plants exposed to 200 Gy and 500 Gy in the first season which gave (6.33 and 7.60 leaves/ plant) compared with its control (6.60 leaves /plant). Concerning no. of shoots/ plant in the first season the 400 and 300 Gy treatments gave the highest values (4.53 and 4.40 shoots/ plant, respectively) while, 500Gy gave the lowest value (2.27 shoots/ plant). On contrast, data obtained from the second season generally showed that there was a decrease in number of shoot /plant in all treated except 100Gy treatment which gave non-significant increase (3.66 shoots/ plant) compared with the control and other treatments.

Data obtained from the first season showed that all treated plants exhibited a significant increase in leaf length compared to the control (Table 1). Treatments with 400 and 300 Gy gave the highest values (33.27 and 31.07cm, respectively) while the control treatment gave the lowest one (24.93cm). At the same side, the second season showed similar results except 500Gy treatment gave a significant

decrease in leaf length (24.13cm) as compared with the control and all other treatments. Generally, plants treated with all doses of gamma rays showed high values of leaf width as compared with the control in the first season. On contrast, data in the second season showed that there was a significant decrease in leaf width in all treated plants except 100Gy treatment which gave the highest value (13.87cm) as compared with the control and other treatments. The three doses (400, 200 and 300Gy) gave the highest values of fresh weight of vegetative growth (1.12, 0.90 and 0.81kg, respectively) at the first season while, the treatments (100, 400 and 500Gy) showed also the highest values (1.88, 1.15 and 1.11kg, respectively) at the second season as shown in Table (1).

Generally, low doses do not cause harmful effects in contrast to higher doses which have drastic effects in most of the studied characteristics (Zaka *et al*., 2004; Dubey *et al*., 2007; El-Beltagi *et al*., 2011). The application of gamma rays on plants induced hormonal and enzymatic alterations, as well as modification in cell cycle which led to exhibit an effect on morphological, physiological and developmental phenomena of plants (Zaka *et al*., 2004; Melki and Marouani, 2010). These alterations could be expressed in progenies either in improvement or suppression of growth and vigor. No clear trend was obvious when various doses were used.

Fruit parameters

Results obtained in Table (2) showed that mean values of fruit weight increased significantly after treatment with all gamma rays doses except 100Gy dose which exhibited non-significant increase (1.61kg) as compared with the control (1.21kg). Plants treated with 200 and 400Gy gave the highest values (2.36 and 2.48 kg, respectively) at the first season. Similar results were recorded in the second season except 500 Gy. The highest number of fruits/plant was found in plants treated with 200 and 400Gy (2.53 and 2.40, respectively). On the other hand, plants treated with 500Gy showed the lowest value of number of fruits/plant (1.2) in the first season. In the second season, plants treated with 400Gy gave the highest value of number of fruits (2.79) as compared with the control (1.57).

Data in Table (2) showed that all doses of gamma rays induced an increase in fruit length except 400 Gy treatment which decreased this trait at the two successive seasons. On the same side, the high doses of gamma rays caused a significant increase in fruit width character as compared with the control in the two successive seasons. As well as, all doses of gamma rays caused a high increase in the values of flesh diameter. The 300Gy treatment gave the highest value (4.50cm) in the first season and also 200 and 300Gy doses gave the same highest value (4.33cm) in the second season. The high doses of gamma rays (300, 400 and 500Gy) caused a positive effect for cavity diameter parameter at the two successive seasons. Moreover, plants treated with gamma rays doses exhibited no changes in rind thickness as compared with the control at the two seasons. Concerning per-

centage of Total Soluble Solids (T.S.S. %) in the first season, only 400 and 200Gy treatments caused a significant increase (14.76 and 13.38%, respectively) as compared with the control (12.33%) while, data obtained from the second season showed a considerable decrease in T.S.S. % in all treated plants except plants treated with 200Gy which gave the highest value (20.67%) as compared with the control and all other treatments.

The content of biological active substances such as, essential oils, glycosides, flavonoids, anthocyanins, and plants mucus did not change significantly after irradiation with gamma rays (Owczarczyk *et al.*, 2000). But the effect of gamma rays on crops showed irregular mitotic, biochemical and physiological alterations. The inhibition of seed germination and elongation of roots and shoots from germinating seeds have been reported for detecting irradiated seeds of crop species (Piri *et al.*, 2011).

Cytological studies

Effect of gamma rays on mitotic phase and index

The effect of various doses of gamma radiation (100, 200, 300, 400 and 500 Gy) on mitotic phase and index (MI) in root tips of *cucumis melo* are shown in Table (3). Results showed that seeds treated with all gamma radiation doses exhibited a significant reduction in mitotic index values as compared with the control (8.74%). Among all gamma radiation doses, the treatment with 100 Gy gave the highest value (5.83%) and treatment with 500 Gy gave the lowest value (3.27%) of mitotic index. Seeds treated with the other gamma radiation doses (200, 300 and 400 Gy) showed similar results in MI (4.12, 4.47 and 4.87%, respectively).

Concerning prophase % data, there was insignificant differences among all tested doses and the control treatment. On one hand, seeds treated with 300 Gy of gamma radiation had the highest value of metaphase % (45.31%) with a significant increase as compared with the control (33.45%) and all other dose treatments except 500 Gy dose which gave 40.43%. On the other hand, gamma treatment of 400 Gy gave the lowest value of metaphase % (23.45%) with a significant decrease as compared with the control and all other doses. Finally, there was a non-significant difference among the control and all tested doses of gamma radiation in percentages of anaphase and telophase phases. Increasing of the metaphase and (ana - telo) phases percentage with most gamma rays treatments refer to the occurrence of aberrations in these stages beside, causing arrest at these stages. While, the reduction in the percentage of prophase stage in most treatments as resulted from reduction in cells number which inter to next mitotic division (Alamoudi, 2016). The inhibition of cell division could be attributed to the inhibitory effect of gamma radiation on the inhibition of different kinds of nuclear proteins which is very important in the mitotic cycle.

These results are in agreement with those of many researchers (Dennis, 1976; Yi-ping *et al.,* 2005; Alamoudi, 2016) after different ionizing radiation treatments such as: neutrons, gamma radiation, X-radiation, electron stream, protons and carbon ion beam in many plants such as: lentil, tomato, broad bean, barely, maize, wheat, onion, rice, and tradescantia.

Increasing the exposure doses of gamma radiation significantly decreased MI% compared to the control. Increasing dosages of gamma radiation caused same effects at *Secale cerale* (Savakan and Toker, 1991), *Hordeum vulgare* (Okamoto and Tatara, 1995) and *Solanum surattense* (Kumar and Roy, 1990). These results are in agreement with our study in two directions, using the same doses of gamma radiation and their effects on MI.

3.2.2. Effect of gamma radiation on mitotic aberrations

The percentages of total mitotic aberrations and some types of aberrations such as; lagging chromosomes, chromosomal bridges, chromosomal fragments, outside chromosome, stickiness and micronuclei in *Cucumis melo* cv. Kahera 6 seeds treated with different doses of gamma radiation have been recorded in Table (4) and Fig. (3). Results indicated that the total mitotic aberrations increased gradually with increasing doses of the gamma radiation. This increasing was significant as compared with the control. Seeds treated with 500 Gy of gamma radiation had the highest value of total aberrations (1.84%) compared with the control (0.19%) and all other doses, while treatment with 100 Gy gave the lowest value (0.60%) compared with all other doses. Increasing of chromosomal aberrations frequency in mitosis along with the doses of gamma radiation might be due to the interactions of ionizing particles with the protoplasm mediated by excitations either directly or indirectly that ultimately has increased aberration frequency (Tripathi and Kumar, 2010). Different types of chromosomal aberrations were detected in seeds treated with different doses of gamma radiation as shown in Table (4). Laggard chromosomes have been noticed in almost all treated seeds with all tested doses except 100 Gy dose which was similar to the control (0.00%). Laggard chromosomes increased gradually with increasing the doses. Lagging chromosomes may be explained on the basis of abnormal spindle formation and failure of chromosome movement (Girija *et al.,* 2013).

Chromosomal bridges were observed with low frequencies (0.02 and 0.10%) in the tested seeds. They appeared only in seeds treated with 200 and 300 and 500 Gy of gamma radiation. Chromosomal bridges were noticed in both anaphase and telophase and may be due to the chromosomal stickiness and after that failure of anaphase separation and thus remain connected as bridges. They may also be a result of chromosome breakage and reunion (Alamoudi, 2016). Concerning chromosomal fragments, they were

recorded in seeds treated with all doses of gamma radiation. The treatments with 300 and 400 Gy had the highest frequency of fragments (0.09 and 0.1 %, respectively) as compared with all other treatments. Chromosomal fragments may be resulted from chromatin erosion and breaks and its evidence for the harmful effect of mutagen (Fiskesjo and Levan, 1993).

Outside chromosomes have been detected in seeds treated with all various doses and control. They were observed with high frequency in seeds treated with all doses compared with the control (0.06%). The treatment 100Gy gave the highest value (0.16%) with significant differences with control (0.06%).

Appearance of outside chromosomes at metaphase may be resulted from disturbance of chromosomes movement at metaphase accompanied by cohesion of centromeres to adjacent inner surface of plasma membrane which failed to move toward the opposite poles of the cell. Our results are in agreement with many workers such as: Kuglik *et al.,* (1990); Maillie *et al.*, 1992).

Chromosomal stickiness increased gradually with increasing gamma radiation doses except 500Gy treatment (0.22%). Data in Table (4) showed that there was a significant increase in stickiness recorded in seeds treated with 400, 300, 500 and 200Gy of gamma radiations (0.34, 0.26, 0.22 and 0.18%) as compared with the control (0.02%). Chromosomal stickiness may be resulted from radiation action on chromosome fibers which lead to interference of chromatin threads. It was found to cover the whole chromosome complement leading to the appearance of loss of chromatin masses (Mateos *et al.*, 1992).; Datta (1995) attributed these stickiness to process of depolymerization of DNA, thus the chromosome surface becomes sticky.

Micronuclei considered the most aberrant aspect of chromosomal aberration which reflects the actual defect in genetic material. The Data in Table (4) showed that all tested gamma doses increased the micronuclei as compared with the control (0.11%). The 500, 400 and 100Gy of gamma doses increased significantly micronuclei % (1.25, 0.65 and 0.33%, respectively) as compared with control (0.11%). Micronuclei were observed in all mitotic phases particularly at interphase and prophase after exposing chromosomes to radiation treatments which cause chromosome damage and disturbed of the mitotic process. It could be caused by acentric fragments or lagging chromosomes which failed to move to the opposite pole during anaphase of mitosis (Artem *et al.*, 2012; Ribeiro, 2012).

SUMMARY

Radiation used as a mutagenic agent in many experiments and the induced mutation is a good tool for plant improvement. This study was carried out to evaluate the effects of various doses of gamma radiation on emergence percentage, vegetative growth and fruit characteristics as well as, their ability to induce

mitotic chromosomal aberrations on seeds of local cultivar of sweet melon (Kahera-6). Generally, the results showed that 500 Gy treatment gave the lowest value of emergence percentage (30%) while the highest values of emergence percentage were given by 0, 100 and 200 Gy treatments. Plants treated with different doses of gamma rays exhibited variable values of vegetative and fruit characteristics compared to the control (0 Gy). Low doses did not caused harmful effects compared to high doses which have drastic effects on most studied characteristics. Our cytogenetic results showed that seeds treated with different doses of gamma radiation exhibited a significant reduction in mitotic index values as compared with the control. Different doses of gamma radiation induced many types of mitotic chromosomal aberrations such as; lagging chromosomes, chromosomal bridges, chromosomal fragments, outside chromosome, stickiness and micronuclei in *Cucumis melo* cv. Kahera-6. In general, our results indicated that the total mitotic aberrations increased gradually with increasing the doses of the gamma radiation. Finally, it could be concluded that using of gamma radiation in this study induced genetic variation, which was reflected on vegetative and yield characters. Using of gamma rays may produce a desired mutant that could be used in plant breeding or improvement programs of sweet melon.

SUMMARY

In conclusion Studying the effect of various doses of gamma radiation on field emergence %, vegetative growth and fruit characteristics as well as, their ability to induce mitotic chromosomal aberrations on seeds of local cultivar of sweet melon (Kahera-6) was conducted in the present work. Results showed that all doses have influence on seed emergence and all other tested characters. The 500Gy dose gave the lowest emergence percentage compared with control and all other doses. Generally, seeds irradiated with gamma rays doses gave different values in all tested vegetative characters in both seasons when compared with control (0Gy). Seeds irradiated with 200Gy of gamma rays gave the highest values of fruit characteristics compared with control and other doses through the two tested seasons. On the other side, seeds treated with all gamma rays doses exhibited a significant reduction in mitotic index values as compared with control. Different types of mitotic chromosomal aberrations such as lagging chromosomes, chromosomal bridges, chromosomal fragments, outside chromosome, stickiness and micronuclei have been observed. Data indicated that the total mitotic aberrations increased gradually with increasing doses of the gamma rays. This increasing was significant as compared with control. Seeds irradiated with 500Gy of gamma rays had the highest value of total aberration (1.84%) compared with all other doses and control (0.20%), while treatment with 100Gy gave the lowest value (0.59%) compared with all other doses. Finally, it could be concluded that irradiation of sweet melon (Kahera-6) seeds with different doses of gamma rays induced mitotic

chromosomal aberrations which may be reflect on vegetative and fruit characters and produce a desired mutant that could be used in plant breeding or crop improvement programs.

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Table (1): The effect of different gamma rays doses on plant height (cm), number of leaves, number of shoots/ plant, leaf length, leaf width, fresh weight (kg) in two successive seasons.

Treat.	Plant height(cm) after 30 days	No. leaves/plant after 30 days	No. Shoots/ Plant	Plant Height (cm) at harvesting	Leaf length	Leaf width	Fresh weight (kg)
1st SEASON							
0Gy	25.80	6.60	2.33	152.50	24.93	11.40	0.52
100Gy	27.73	8.33	3.00	174.10	27.53	12.20	0.62
200Gy	23.27	6.33	2.33	195.50	28.33	13.07	0.90
300Gy	32.92	10.13	4.40	204.30	31.07	13.20	0.81
400Gy	28.47	10.53	4.53	192.10	33.27	12.73	1.12
500Gy	22.87	7.60	2.27	183.90	28.33	12.28	0.77
$LSD_{0.05}$	3.31	1.36	0.77	19.68	2.12	0.41	0.27
2nd SEASON							
0Gy	22.60	6.80	3.64	230.70	25.13	13.13	0.79
100Gy	27.60	9.47	3.66	272.70	27.60	13.87	1.38
200Gy	28.00	10.00	3.46	273.00	26.47	12.60	0.78
300Gy	38.53	10.87	3.40	316.00	29.47	12.07	0.79
400Gy	28.20	8.07	3.40	202.00	36.00	11.87	1.15
500Gy	33.73	9.87	3.33	202.80	24. 13	11.40	1.11
$LSD_{0.05}$	1.24	1.01	0.37	19.62	0.94	0.40	0.14

Table (2): The effect of different doses of gamma rays on fruit weight, no. fruits/ plant, fruit length, fruit width, flesh diameter, cavity diameter, rind thickness and T.SS% in two successive seasons.

Treat.	Fruit weight	No. fruits/ plant	Fruit length	Fruit width	Flesh diameter	Cavity diameter	Rind thickness	T.S.S%
1st SEASON								
0Gy	1.21	1.67	17.67	13.00	2.50	7.50	0.50	12.33
100Gy	1.61	1.40	25.00	13.00	3.50	6.33	0.50	11.50
200Gy	2.36	2.53	24.33	13.00	4.00	5.00	0.50	13.38
300Gy	2.11	1.73	23.00	14.33	4.50	8.00	0.50	12.67
400Gy	2.48	2.40	12.33	15.33	3.50	10.50	0.50	14.76
500Gy	2.09	1.20	24.00	18.00	4.17	8.60	0.50	13.00
$LSD_{0.05}$	0.68	0.49	1.41	1.46	0.41	0.13	0.40	0.69
2nd SEASON								
0Gy	1.45	1.57	17.67	13.17	2.60	7.83	0.53	15.00
100Gy	1.08	2.20	23.67	13.67	3.50	6.33	0.50	14.00
200Gy	1.91	2.19	22.67	13.50	4.33	5.50	0.47	20.67
300Gy	1.73	2.00	18.67	14.17	4.33	8.33	0.43	12.67
400Gy	1.83	2.79	15.50	16.50	3.00	9.83	0.50	10.00
500Gy	1.62	2.20	23.00	16.63	4.00	9.00	0.50	13.33
$LSD_{0.05}$	0.20	0.26	5.74	0.85	0.53	0.59	0.12	3.04

Table (3): Percentages of different phases and mitotic index (MI) obtained from root tips of *cucumis melo* treated with various doses of gamma radiation.

Treatment	Total No. examined of cells	T. no. of divided cells	Prophase%	Metaphase%	Anaphase & telophase %	MI%
Control	3500	306	43.06	33.45	23.49	8.74
100Gy	3636	216	36.51	36.79	26.70	5.83
200Gy	3954	165	40.35	35.43	24.22	4.12
300Gy	3616	163	30.20	45.31	24.49	4.47
400Gy	2316	112	44.92	23.45	31.63	4.87
500Gy	4028	131	47.61	40.43	11.96	3.27
$LSD_{0.05}$			18.05	7.32	14.99	1.45

Table (4): Percentages of total mitotic abnormalities obtained from root tips of *Cucumis melo* treated with different doses of gamma radiation.

Treat-ment	Total no. of exam-ined cells	Laggard chro-mosom e%	Chro-moso mal Bridge %	Chromo-somal Frag-ment%	Outside chro-mosom e%	Chromo-somal Sticki-ness%	Micronu-clei%	Total Aberra-tions%
Control	3500	0.00	0.00	0.00	0.06	0.02	0.11	0.19
100Gy	3636	0.00	0.00	0.03	0.16	0.08	0.33	0.60
200Gy	3954	0.03	0.10	0.05	0.07	0.18	0.25	0.68
300Gy	3616	0.05	0.02	0.09	0.09	0.26	0.20	0.71
400Gy	2316	0.09	0.00	0.10	0.13	0.34	0.65	1.31
500Gy	4028	0.12	0.10	0.05	0.10	0.22	1.25	1.84
LSD0.05		0.02	-	0.03	0.10	0.12	0.21	0.32

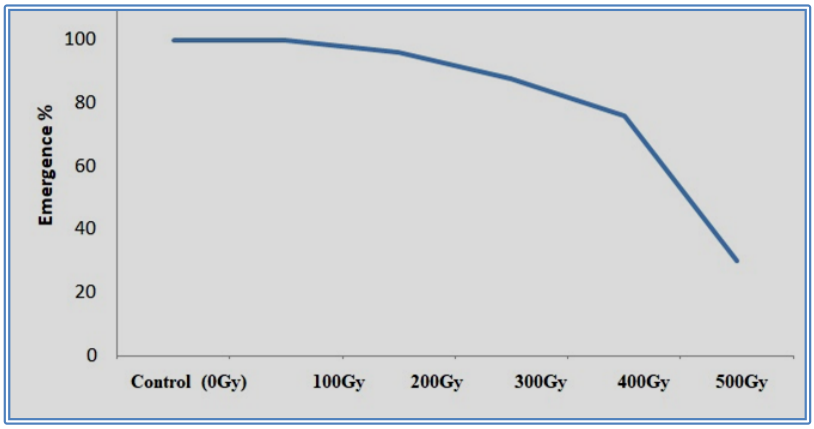

Fig. (1): Effect of different gamma ray doses (0, 100, 200, 300, 400 and 500Gy) on plant emergence %.

Fig.(2): Some morphological characteristics on sweet melon plants treated with different doses of gamma rays, (A), (B) and (C) variation in the leaf shape and (D), (E) and (F) variation in shape and size of the fruit at the same age.

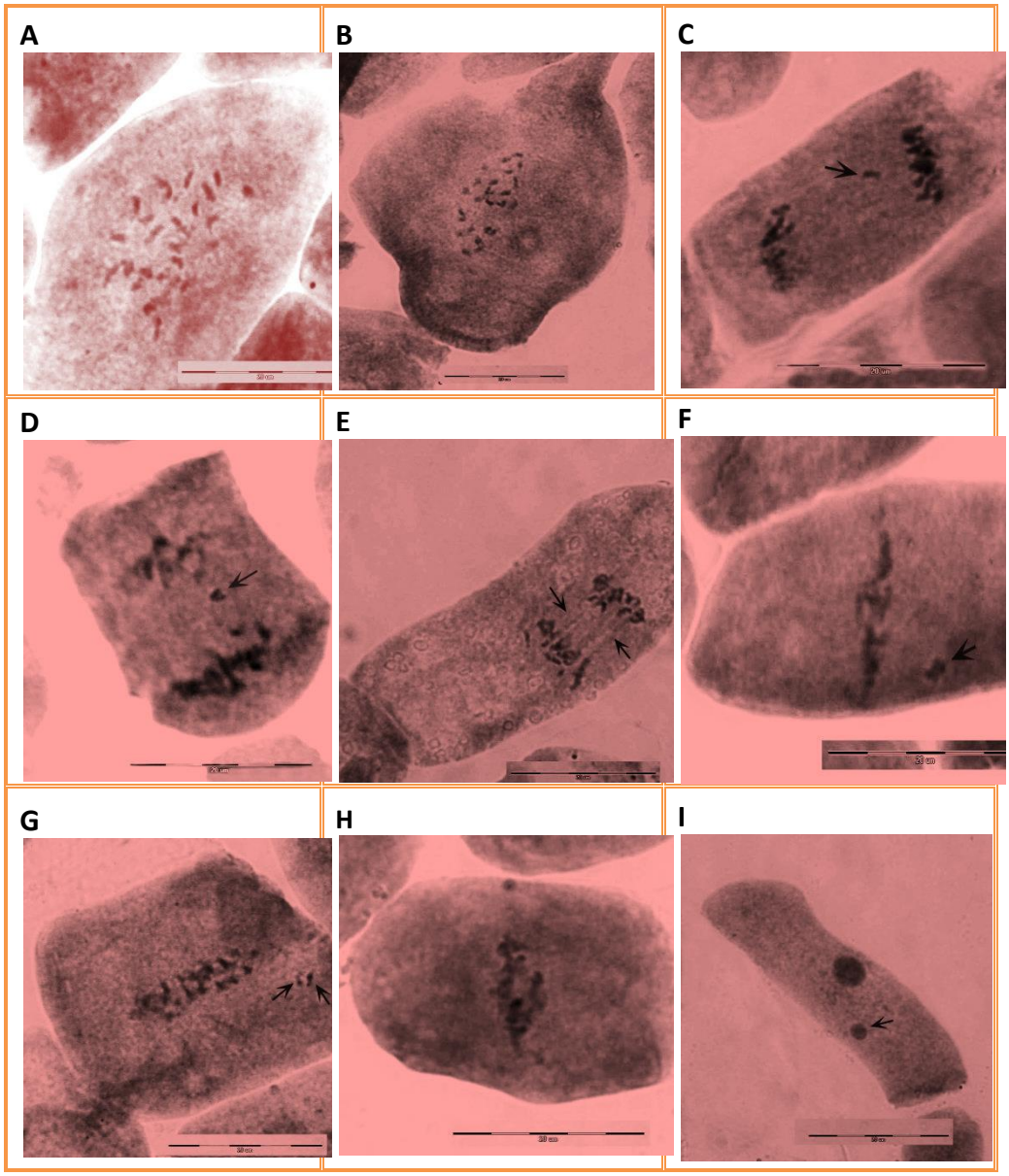

Fig. 3: Some types of mitotic chromosomal aberrations at different mitotic stages of *cucucmis melo*: (A) and (B) normal metaphase (2n=24), (C) and (D) lagging chromosomes at anaphase, (E) multibridges at anaphase, (F) and (G) outside chromosomes at metaphase, (H) chromosomal stickiness at metaphase and (I) micronuclei at interphase,. Scale bar = 20 microns.