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Propagation of mango seedlings of the cultivar "Tom-my" by grafts irradiated

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ABSTRACT

Due to difficulties of vegetative propagating of any pants, many tests were performed with ionizing radiation aiming the modification of the characteristics of the plants for obtaining of the improved genotypes and of smaller size. Rootstock "Espada" cultivar, were used to obtain mango seedlings of "Tommy" cultivar. The cuttings were irradiated with different gamma radiation doses: 0 (control), 2.5, 5.0, 7.5 and 10.0 Gy, a dose rate of 0.323 kGy/h, in a source of Cobalt-60 type Gammacell-220, installed in the Center for Nuclear Energy in Agriculture, CENA-USP. After irradiation, was performed the grafting type cleft graft. It was made the first evaluation of height of the plants from the budding grafting after 24 months. Data were subjected by statistic program (SAS) and the means were compared by Tukey test (p <0.05). From the results obtained can be concluded that the doses of 2.5 Gy stimulated growth of the plants and the lethal dose was 10.0 Gy because don't have development of plants.

Keywords: **irradiation, mango plant, propagation.**

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1. INTRODUCTION

The good performance in domestic and foreign markets throughout 2017 is celebrated by the production chain of mangoes in Brazil. Domestically, the volume of fruit sold increases every year, while shipments add up to record exports, both in volume and in revenue. By 2018, the projection is again to increase production, due to the mood of the producers with the results obtained in recent harvests. In the São Francisco Valley, there was a 5.5% increase in cultivated area in 2017, according to the Center for Advanced Studies in Applied Economics (Cepea), Luiz de Queiroz College of Agriculture (Esalq), linked to the University of São Paulo (USP). Researcher João Ricardo Ferreira de Lima, from Embrapa Semiarido, explains that the latest consolidated data is from [1].

According to figures from the Brazilian Institute of Geography and Statistics (IBGE, 2016) the area harvested in Brazil was 61,842 hectares, with a production of 1 million tons. Productivity reached 16.2 tons per hectare, with an estimated production value of R$ 788,351 million. In comparison with the previous stage, there was a slight decrease in the area harvested (in 2015, there were 64,263 hectares), but there was an increase in the amount produced, since the harvest was 976,012 tons in 2015 [1].

According to Arthur, Cantuarias-Avilés, Ferrari [1] to gamma irradiation has been used with the aim of plant breeding to induce mutations which gave rise to numerous commercial cultivars. The difficulties of vegetative propagation in avocado has been reason for seeking alternative methods and one that is currently being widely used is the use of ionizing radiation in order to modify the characteristics of plants and their standard of vegetative growth to obtain improved genotypes and smaller. The irradiation of plants and seeds with low doses of ionizing radiation can promote acceleration or increase germination, larger plant growth, increased agricultural production, etc. The gamma radiation doses used to achieve these benefits are not enough to cause changes in the gene pool of irradiated organism, being these low radiation doses applied on plants calls of hormesis [2,3,4,5,6,7].

The ionizing radiation is being used since a long time as an alternative method for inducing mutations in seeds, stems, tubers, cuttings, tissue culture annual plants, ornamentals and some fruit species, as part of a breeding program that originated many commercial cultivars [8, 9]. Works with avocado also were conducted to evaluate the effects of radiation to obtain mutations induced in plants with improved genotypes [10, 11, 12, 13].

The irradiation with gamma rays of a product consists in its exposure to a source of isotopes for a time sufficient for have absorption of radiation dose required [14]. Among the gamma radiation sources, the Cobalt-60 is the most used because it is an insoluble metal in water, with larger environmental safety [15].

The radiation dose are measured in terms of energy absorbed by the irradiated product, using as the unit the Gray (Gy) which corresponds absorption of 1 joule of energy per 1kg of mass.The dose rate corresponds the radiation emitted by the source per unit of time and per hour measured in gray (Gy/h). Therefore, to irradiate a product with a particular dose is necessary know the dose rate of the source to calculate the exposure time needed to achieve the required dose absorbed [16].

Nevertheless, products exposed to the gamma rays do not become radioactive, because they do not come into direct contact with the radioactive source and because the absorbed energy is not sufficient to induce radioactivity in order that the application of the radioactive treatment is safe and leave no residues [17].

Already Arthur, Cantuarias-Avilés, Ferrari [1] used the gamma radiation in seeds of different cultivars avocado for propagation of plants and concluded that in the dose of 15 Gy was an increase in the tillering of avocado sprouts without affecting the germinative capacity and the final size of the obtained sprouts, thereby reducing the amount of seed required for propagation. Furthermore the exposure avocado seeds at high radiation doses to propagation effects is not recommended because it reduces the germination and decreases the size of the germinated plants.

The objective of the work was utilize “espada” variety mango cuttings of in the propagation of irradiated seedlings of the Tommy variety.

2. MATERIAL AND METHODS

The experiment was performed in department of plant production of the Luiz de Queiroz College of Agriculture - ESALQ / USP. The experiment was conducted in a greenhouse. For the formation of rootstock, seeds of the variety “Espada” mango were used, the seeds were placed for germination in pots with 14 cm diameter by 31 cm height containing soil latosol medium.

The grafts Tommy variety were irradiated with gamma radiation doses: 0 (control), 2.5, 5.0, 7.5 and 10 Gy, in a cobalt-60 source type Gammacell-220, installed in the Center for Nuclear Energy in Agriculture, CENA-USP under a dose rate of 0.323 kGy / h. After irradiation, slit type grafting was performed when the rootstocks were on average 25-30 cm height, and the diameter ranged from 0.5 to 0.7 cm. The graft length was 6.0 cm. The grafting height was taken to 5 cm. After grafting, plastic bags were placed over the stem grafted of the plants to conserve the humidity.

Were performed first evaluation of the plants height from the sprouting of the grafting, 24 months after grafting of the plants. The diameter of the plant was evaluated in directions parallel. The experiment was in randomized blocks, with five treatments and four replicates by each treatment, data were submitted to analysis of variance and the means were compared by Tukey test ($p < 0.05$).

3. RESULTS AND DISCUSSION

In Table 1 it has medium values of plants with flowers, heights and diameter of plants in cm in the first evaluation of cultivar Tommy mango from irradiated grafts with increasing gamma radiation doses of 0, 2.5, 5.0 and 7.5 Gy from a cobalt-60 source.

The first evaluation of the plants of mangoes plants of the Tommy variety from sprouting of the grafting after 24 months, the results are showed in the table1. By the results we observe that the values of the total heights, above graft, diameter and flower of the plants in the first evaluation showed statistical significance only in the dose of 2.5 Gy in comparison with the treatments in the

columns. In the dose of 10.0 Gy doesn't have development of the plants therefore being this the lethal dose for the grafts of the Tommy mango.

Table 1. Medium values of plants with flowers, heights and diameter of plants in cm in the first evaluation of cultivar Tommy from irradiated grafts with increasing gamma radiation doses from a cobalt-60 source.

Doses/Gy	**Total height**	**Above of graft**	**Diameter**	**Flowers/plant**
Control	223.0 ± 2.5b	157.0 ± 1.9b	170.0± 1.8a	0.00b
2.5 Gy	241.0 ± 1.9a	183.0 ± 1.5a	172.0± 1.8a	0.25a
5.0 Gy	217.0 ± 1.7b	152.0 ± 1.2b	164.0 ± 1.3b	0.00b
7.5 Gy	216.0 ± 0.0b	144.0 ± 0.0b	154.0 ± 0.0c	0.25a

Means followed by the same letter do not differ by Tukey's test at 5%.

In general the results obtained by this first evaluation of the experiment are satisfactory in relation to effects of gamma radiation on rootstocks induced a stimulating effect with the dose of 2.5 Gy. Doses above caused an inverse effect in the growth of the plants being similar the results of Arthur, Cantuarias-Avilés, Ferrari [1] when irradiated avocado seeds and stimulated the tillering of avocado sprouts without affect the germination capacity and the final size of the obtained sprouts, thereby reducing the amount of seed required for propagating purposes. Another important factor to emphasize is that these plants may exhibit changes in their characteristics as the increase or decrease in vegetative growth and may result in obtaining of some improved genotypes, smaller and with higher production than plants obtained from non-irradiated grafts or control plants.

4. CONCLUSION

From the results obtained it concluded that a dose of 2.5 Gy stimulated growth of the plants and doses above of 2.5 Gy reduced. The lethal dose was 10.0 Gy.

REFERENCES

[1] ARTHUR V.; CANTUARIAS-AVILÉS T.; FERRARI L. Use of gamma-ray irradiation on seeds of different avocado cultivars for propagation purposes. Proceedings **VII World Avocado Congress 2011 (Actas VII Congreso Mundial del Aguacate 2011).** Cairns, Austrália. 5 – 9 September v.1, p. 245, 2011.

[2] FRANCO S. S. H. **Interrelação de radiohormese e a incidência de insetos pragas na cultura de milho *Zea mays* L.** Tese Doutorado - Universidade de São Paulo, 1999. 67p.

[3] FRANCO C. H.; SILVA R. M. G.; ARTHUR V.; FRANCO S. S. H.; FRANCO J. G. Avaliação da germinação e desenvolvimento de *Lactuca sativa* l. (Asteraceae) provenientes de sementes irradiadas. **XXII Congresso de Iniciação Científica** (Unesp) Assis/SP, v. 1, p. 1179-1181, 2010.

[4] BOVI J. E.; ARTHUR V.; TESSARIOLI NETO J. Uso de baixas doses da radiação gama de Cobalto-60 em sementes de rabanete e seus efeitos no desenvolvimento da planta, produção e armazenamento de raízes. **Revista de Agricultura**, v. 75, n.2, p. 373-386, 2000.

[5] HARDER M. N. C.; GUEDES B. G.; ARTHUR V. Determinação do índice de germinação de sementes de urucum (*Bixa orellana*) submetidas à radiação gama para quebra de dormência. In: **http://www.usp.br/siicusp/Resumos/15Siicusp/4271.pdf.**

[6] FONTES L. S.; ARTHUR P. B.; ARTHUR V. Efeitos da radiação gama em sementes de feijão (*Vigna unguiculata* L.) visando o aumento de produção. **Revista Verde** (Mossoró – RN - BRASIL), v. 8, n.4, p. 11 - 14, 2013.

[7] FRANCO J. G. **Influência de diferentes doses de radiação gama (Co^{60}) em sementes de**

soja *Glycine max* (L.) visando aumento de produtividade. Tese de doutorado IPEN, 2018. 66 p.

[8] PRZYBLA A. Mutational breeding of vegetatively propagated plants', **Revista Chapingo** (Serie Horticultura), v. 1, n. 1, p.145-150, 1994.

[9] MALUSZYNSKY M.; NICHTERLEIN K.; VAN ZANTEN L.; AHLOOWALIA S. Officially released mutant varieties-The FAO/IAEA database', **Mutation Breeding Review**, n. 12, p.1-84, 2000.

[10] DE LA CRUZ E.; RUBI M.; SANDOVAL L.; GARCIA-ANDRADE J. M. Architecture variability on Hass avocado subjected to $_{60}$Co gamma irradiation. **Proceedings of 17 Phytogenetic, Congress**, Acapulco, 1998. p. 76.

[11] DE LA CRUZ E.; RUBI M.; FALCON B. Efecto de la radiación gamma sobre el desarrollo vegetativo y reproductivo de aguacate cv. Hass', **Proceedings of Salvador Sánches Colín Foundation Meeting**, CICTAMEX, S.C., Coatepec Harinas, 1995. p. 55-60.

[12] DE LA CRUZ E.; RUBI M.; SAAVEDRA C. Advances on the radioinduced mutation breeding program on avocado at CITAMEX', **Proceedings of III Word Avocado Congress**, Tel Aviv, 1995. 120 p.

[13] RUBI M.; DE LA CRUZ E.; HERNANDEZ A. Desarrollo vegetativo de diferentes selecciones de aguacate irradiadas con 60Co. Memorias de Actividades de la Fundación Salvador Sánchez Colín CICTAMEX, S.C., **Coatepec Harinas**, 1992. p. 59-68.

[14] CHITARRA M. I. F.; CHITARRA A. B. **Pós-colheita de frutas e hortaliças: fisiologia e manuseio**. UFLA, Lavras. 2005.130 p.

[15] VIEITES R. L. **Conservação pós-colheita do tomate através do use da radiação gama, cera e saco de polietileno, armazenados em condições de refrigeração e ambiente.** Tese de Livre Docência, Faculdade de Ciências Agronômicas, Universidade Estadual Paulista, Botucatu. 1998. 131p.

[16] LUCKEY T. D. **Hormesis with Ionizing Radiation**, CRC Press, Boca Raton. 1980.

[17] O'BEIRNE D. Irradiation of fruits and vegetables: applications and issues', **Professional Horticulture,** v. 3, n. 1, p. 12-19, 1989.