

EFFECTS OF LOW DOSES OF GAMMA IRRADIATION ON PINE NUTS (*ARAUCARIA ANGUSTIFOLIA*)

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ABSTRACT

The *Araucaria angustifolia*, is known as the “Pinheiro-do-Parana”, Brazilian pine, Pine, Pine Tree Monkey, emerges as the main representative of the Rain Forest, also known as Araucaria Forest, part of the Atlantic Forest biome (Decree Law 750/1993). A major problem in implementing this plan is to stand the loss of germination of seeds. The storage conditions of the seeds of species, some time have been the subject of studies by various researchers. Several studies have shown that ionizing radiation can increase the germination rate, to break dormancy and plant production, thus appearing as an alternative method to increase the production of economically important crops. Despite the "Hormesis Theory" have been confirmed in experiments and observations made over the years, relatively few researchers who are dedicated to the study of this phenomenon. Due to losses of germination of pine nut, the aim of this work was to study the effect of low doses of gamma radiation on pine nut. The seeds were bought locally in the city of Piracicaba and irradiated with 0 (control), 0.25, 0.50, 0.75, 10, 12, 5, 15.0 and 17.5 Gy. Subsequently the seeds were planted in a plastic cup containing vermiculite as substrate. Evaluations of the germinated seeds number and measure the size of the plants every 10 days. The results indicated that the dose of 0.25 Gy there was a greater number of plants germinated and irradiation stimulated the growth of these plants. Already a lethal dose of the seeds was 15 Gy.

Key words: seeds, pine nuts, irradiation, germination.

1.INTRODUCTION

Araucaria angustifolia (Bert.) it is a characteristic species of the Brazilian subtropical forest, known as pine tree-Brazilian, pine tree-Paraná or Araucaria. The species happens in several Brazilian states, like Rio de Janeiro, Minas Gerais, São Paulo, Paraná, Santa Catarina and Rio Grande do Sul. For occupying extensive areas, your indiscriminate exploration was put in the official list of the species of the threatened of extinction in Brazilian flora [1].

Of the 20 million hectares originally covered by the Forest of Araucaria, they remain, now, about 2% of that area. Particularly in the State of Paraná, the sawmills and the industrial use they were the main ones responsible for the deforestation. Another factor that is contributing to the vulnerability of the species is the fact of the seeds have short natural longevity, with total loss of viability in to one year after the collection [2].

Due to that one of the main problems in the implantation of reforestation of the plant is the loss of the power of germination of the seeds. The condition of storage of the seeds of the mentioned species already of some time has been objective of studies done by several researchers. Regarding the effects of low doses of radiation several works they have been demonstrating that the irradiation ionization can increase the germination, to break the dormancy the production of plants, appearing as well as an alternative method to increase the production of cultures of economical importance.

According to [3], hormesis is the stimulation through low doses of any agent potentially harmful. Radiohormesis are, therefore, radiations in low doses that promote incentives to certain organism. Radiations ionization have a chance the possibility to reach the organism entirely, almost stimulating all of the cells that instantly, what doesn't happen with the use of chemical substances.

In agreement with [4], studied the effects of radiations range, in sleeping seeds of oats, with doses among 10 to 60 kR, the dose of 10 kR promoted germination of 93% of the treated seeds, while the witness had only 58% of germination. The highest doses inhibited the germination.

Several authors tell although the use of radiations ionization increases the rate of respiration [5, 6, 7] and that the germination can be activated with the use of high concentration of oxygen [8] and agents as peroxide of hydrogen - H_2O_2 [9].

The "Theory Hormesis" has been if confirmed in experiments and observations accomplished along the years, they are relatively few the researchers that are devoted to the study of this phenomenon. The evaluation of the growth of the plants in function of the dose is related to many factors that include the species of the plant, stage in that the plants were irradiated and the environmental conditions in that were made the irradiations [10].

Studied the effects of the radiation gamma on seeds of several wheat varieties, barley and corn and depending of the variety inside of the same species, similar answers could

be obtained with different doses and that the stimulating dose for a variety can be even inhibitory for other [11].

Irradiated pine seeds with different radiation doses gamma and they concluded that in it measured the doses of 100, 200 and 400 R, were the best stimulated, the power germination of the seeds and the height of the plants [12].

Due to that the objective of this research was to study the effect of low radiation doses gamma on seeds pine to increase the power germination of the seeds.

2. MATERIAL AND METHODS

The pine seeds were acquired in the trade of Piracicaba / SP, and taken for the laboratory of Radiobiology and Ambient of the Center of Nuclear Energy in the Agriculture of the University of São Paulo. Those seeds were separate in groups and irradiated with doses of: 0 (control) 0,25; 0,50; 0,75; 10; 12; 15 and 17,5 Gy, in a source of Cobalt-60, type Gammacell-220, under a dose rate of 0,426 kGy/hour.

Soon afterwards the pine seeds were planted in the vermiculite in glasses of polystyrene holed, with capacity of 600ml. were used 8 (eight) glasses with 2 (two) seeds each in total of 16 seeds for each treatment. The experiment was developed at a room with temperature of $25 \pm 5^\circ \text{C}$ and relative humidity of $60 \pm 70\%$. The plants were evaluated for a period of 90 days, was made the measure of the height of the each germinated plant.

Was made the analyzes of variance of the results obtained by the test F and the comparison of the measured obtained in the different treatments according to the test of Tukey at the level of 5% through the program Software Statistical Analysis System (SAS).

RESULTS AND DISCUSSION

In the Table 1 we have the number and the percentage of germinated plants of the pine seeds irradiated with doses of gamma radiation. For the results of the Table we can observe that the dose of 0.25 Gy was that presented the largest number of plants germinated in relation to other treatments. Already the lethal dose to inhibit the germination of the seeds was the of 15 Gy.

Table 1. Number and percentage of pine seeds germinated after the treatment with increase doses of gamma radiation of the Cobalt-60.

Doses Gy	Seeds germinations	ger minations %
0	10	62,5
0,25	13	81,2
0,50	11	68,7
0,75	5	31,2
10,0	10	62,5
12,5	1	6,2
15,0	0	0
17,5	0	0

Table 2. Number medium of the height of the plants coming of seeds irradiated with increase doses of gamma radiation of the Cobalt-60.

Doses/Gy	Evaluations								
	1°	2°	3°	4°	5°	6°	7°	8°	9°
0	0,8±0,1b	1,3±0,2ab	2,7±0,6a	3,7±0,7ab	9,9±2,6ab	11,2±3,1ab	12,9±4,6ab	13,3±4,1ab	13,8±4,4ab
0,25	1,1±0,1a	1,7±0,3a	3,1±0,6a	4,3±0,7a	12,4±2,9a	14,4±3,0a	18,2± 2,2a	19,6±1,7a	20,6±1,8a
0,5	0,3±0,2c	0,7±0,4bc	1,1±0,4b	2,0±1,2bc	6,9±3,6abc	8,2±4,3ab	10,9± 5,7ab	11,0±5,8ab	11,3±6,1abc
0,75	0,0± 0,0d	0,1±0,1cd	0,4±0,4b	0,8±0,8cd	3,5±3,3bcd	4,3±4,0bc	5,3±5,0bc	5,5±5,5bc	6,0±6,0bcd
10,0	0,0±0,0d	0,3±0,2cd	0,7±0,4b	0,9±0,6cd	4,2±2,1bcd	4,3±2,8bc	6,5±4,3bc	7,5±4,7bc	7,0±4,9bcd
12,5	0,0±0,0d	0,0±0,0d	0,0±0,0b	0,0±0,7d	0,2±0,2cd	0,2±0,2c	0,5± 0,5c	0,5±0,5c	0,5±0,5cd
15,0	0,0±0,0d	0,0±0,0 d	0,0±0,0b	0,0±0,0d	0,0± 0,0d	0,0±0,0c	0,0±0,0c	0,0±0,0c	0,0±0,0d
17,5	0,0±0,0d	0,0±0,0d	0,0±0,0b	0,0±0,0d	0,0± 0,0d	0,0±0,0c	0,0±0,0c	0,0±0,0c	0,0±0,0d

Different letters in the columns indicate significant statistical difference at the level of 5%.

For the results of the Table 2 we can observe that the dose of 0,25 Gy was the that presented statistical difference in most of the evaluations in relation to other treatments, with doses above of 0,50 Gy. In spite of they present not statistical difference the dose of 0,25 Gy in measured was the that presented the largest results of height of the plants, therefore that dose was the that induced larger effect of the gamma radiation in the growth in the plants germinated after 90 days of evaluation. As already mentioned previously the dose of 15 Gy was the lethal for all of the irradiated seeds.

CONCLUSIONS

The results indicated that the dose of 0.25 Gy there was a greater number of plants germinated and irradiation stimulated the growth of these plants. Already a lethal dose of the seeds was 15 Gy.

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