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GENETIC IMPROVEMENT OF SOME ATTRIBUTES AGRONOMIC IN ROSELLE (MALVACEAE) WITH GAMMA RADIATION OF 60Co

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ABSTRACT

In order to determine the effect of eleven levels of ^{60}Co gamma radiation on some agronomic attributes of Jamaica, seeds were irradiated in Transelektro LGI-01 model at the Instituto Nacional de Investigaciones Nucleares. The plants were planted in black polyethylene bags of 5 kg capacity, using as substrate tezontle red and using the Steiner nutrient solution. The variables evaluated were: root lodging, germination percentage, plant height, seed yield and chalice, which were evaluated under a completely randomized design with four replications (11x3) = 33 experimental units, with data from germination dose curve radiosensitivity was determined. The results indicate that the root lodging and plant height were positively affected by radiation. The percentage of germination was minimally affected by radiation and higher seed yields and chalice were achieved with 5 and 10 Gy. In this study it can be concluded that to obtain a better fit in the crook of radiosensitivity, the range of irradiation may be due to increase to 1 kGy.

INTRODUCTION

In Mexico the cultivation of Jamaica has been underexploited despite having climates and microclimates suitable for growing, the southern states of Guerrero and Oaxaca are the main producers with 85% of national production, and whose average yield is 265 kg ha^{-1}. Currently this plant has become important due to its medicinal properties such as diuretic, cholesterol decreased due to the presence of statins (Ariza *et al*., 2014).

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Among other uses, you can cite the roselle for its antimicrobial properties due to the polyphenol content (Delgado, 2016), as well as for fiber extraction of their stems especially xylem and phloem of ducts, pulp papermaking and in some regions of Cuba is used as forage (Vinent, 2011). Regarding the breeding is a technique as old as agriculture itself because the man when he becomes sedentary, he had the need to improve the productive potential of its plants and animals, which were for food and to this day, have emerged techniques for this activity within which we can cite: selecting either individually or mass selection, breeding, introgression, use of plasmids and mutagenesis in its forms: physical mutagenesis and chemical (Camarena *et al*., 2012). So under this trend, mutagenesis is defined as a technique for genetic improvement based on the

power of inducing mutations in the DNA molecule, by some physical agents such as gamma radiation emitted by some radioactive, elements such as 60Co, X rays and sometimes ultraviolet (Novak and Brunner, 1992). Its principle is based on the highly penetrating gamma radiation due to the having short wavelength, causing the break hydrogen bridges that bind the purine and pyrimidine bases that are part of DNA nucleotides, so these damages that often can not be repaired by the DNA repair mechanism, they demonstrated directly in the genes, the material or tissue that is subjected to radiation (Mercado, 2007). Therefore, the main objective was: assess the effect of eleven levels of gamma radiation 60Co on some attributes of agronomic interest in the cultivation of roselle.

Hungarian at the Instituto Nacional de Investigaciones Nucleares (ININ), located in Salazar, State of Mexico. The doses used in this study were 0, 5, 10, 15, 20, 25, 30, 35, 40, 45 and 50 Gy.

Establishment of the experiment and determination of the LD_{50}

Irradiated seeds were sown in polystyrene trays of 200 cavities and once germinated They were planted when they were 15 cm height, they were planted in black polyethylene bags 7 kg capacity using as substrate tezontle red and irrigated with nutrient solution Steiner. In this first study, the germination percentage is determined using the equation PG = GS / SS

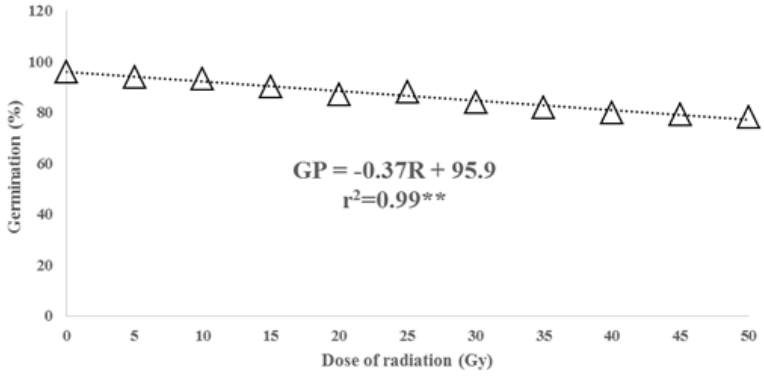

Figure 1. Radiosensitivity curve seeds roselle (*Hibiscus sabdariffa* L.), under eleven levels of gamma radiation from ^{60}Co, at the Universidad Tecnológica de Tehuacán. Cycle Summer-Autumn, 2015. GP, germination percentage; R, radiation dose

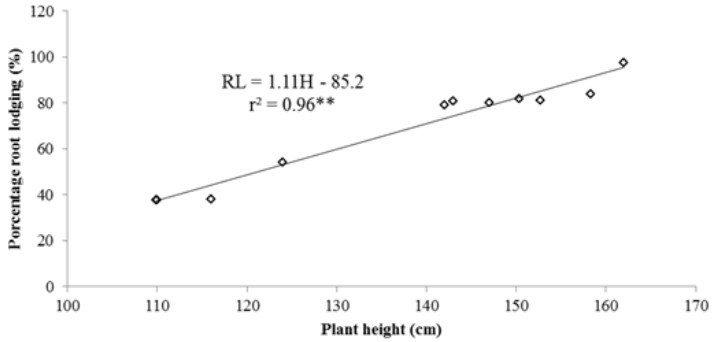

Figure 2. Regression model plant height vs root lodging in roselle seeds (*Hibiscus sabdariffa* L.) irradiated with ^{60}Co range. Universidad Tecnólogica de Tehuacán. Cycle Summer-Autumn, 2015. PRL, percentage of root lodging; H, plant height

MATERIALS AND METHODS

Location of the experiment

This research was conducted at the Universidad Tecnologica de Tehuacan, located in San Pablo Tepetzingo Tehuacán Puebla, México at 18° 24´ 51´´ north latitude, 97° 20´´ 00´´ west longitude and 1409 meters above sea level.

Genetic material and irradiance

The germplasm used, seeds were collected from an accession open-pollinated on the big coast of Oaxaca, corresponding to chalice red and white corolla gamosepala, which they were irradiated in Transelektro model LG-01 of manufacture

where: PG, percentage of germinated seeds; GS, germinated seeds and SS, sown seeds. With data percentage of germinated seeds, it traced the curve radiosensivilidad determine the LD_{50} for ^{60}Co gamma radiation using a simple linear regression, by least squares technique.

Response variables

The response variables were: root lodging, calculating the percentage of plants that are root lodging in a 60% greater angle to the vertical in each experimental unit; germination percentage; plant height, measured from the neck of the plant to the apical bud; seed yield, weighing the total seed contained

in each capsule of all these per plant using an analytical balance and weight chalices weighing the total calices per plant.

Design and experimental unit

The experimental unit consists of four bags of polyethylene substrate and a plant of roselle. The experimental design was completely random, under the mathematical model $Y_{ij}=\mu+T_i+\varepsilon_{ij}$, where Y_{ij}, is the response variable i-th level of radiation in the j-th repetition; T_i, it is the effect of the i-th level of radiation; ε_{ij} is the experimental error of the i-th level of radiation in the j-th repetition (Infante y Zarate, 1990). When the response variables are significant, they are applied Tukey's multiple comparison to a significance level of 5% probability of error.

RESULTS AND DISCUSSION

In Figure 1, radiosensitivity curve seeds roselle is presented and it can be seen, the data fit a linear model with a downward slope -0.37 indicating for each Gy radiation decreases germination in 0.37 %. Thus the maximum radiation dose 50 Gy, germination was reduced up to 28% indicating that must expand to achieve LD_{50} irradiation range of perhaps 500 or 1000 Gy. Regarding the coefficient of determination, This was elevated and highly significant 0.99. This response has been corroborated by Ramirez *et al*., (2006), who irradiated seeds of four varieties of tomato (*Lycopersicon esculentum* Mill.) and mentioned that at doses of 100 Gy to 0, the response decreased germination by stimulating effect of radiation is zero or near zero.

Regarding the analysis of variance of the response variables studied, in Table 1 it can be seen that all study variables showed highly significant differences, thus the coefficient of variation was very reliable values as this ranged between 4.06 and 12.37%. In relation to root lodging, the highest percentage seen in the witness with 97.66 %, followed by doses of 5-30 Gy who were statistically equal, while doses of 40 to 50 Gy, They presented the lowest percentages of lodging. Germination percentages as mentioned in the curve radiosencibilidad were affected minimally by effect of ionizing radiation. Plant height has decreased with the application of 35 to 50 Gy 23.4%, respect to the highest point this was found in the control treatment followed by 10 and 15 Gy with 152.66 and 150.33 cm who also were statistically equal. Seed yield was higher for the control treatments, 5, 10 and 20 Gy, thus lower production of seed was the application of 40 to 50 Gy with 10.80, 10.00 and 8.90 g $plant^{-1}$ respectively. Performance follicle, was stimulated with 5 and 10 Gy, which are the highest values with 84.86 and 83.53 g $plant^{-1}$, while the lowest was in doses 35, 40, 45 and 50 Gy resulting statistically equal.

These results agree with those reported by Diaz *et al*., (2003), who mentioned that plant height in *Tigridia pavonia* (L. F.) DC var. Sandra when subjected to radiation of 30 Gy decreases the generation V_1. Meanwhile Aguilar *et al*. (2013), mention that application of 60Co gamma radiation of less than 1000 Gy, can induce somatic mutations are useful as in the production of new varieties of *Vigna unguiculata* L. This suggests that in order to induce greater genetic variability, in the cultivation of Jamaica and get new attributes of agronomic interest, the range of radiation to treat seeds should be expanded perhaps up to 1 kGy, as they mentioned Fe *et al*., (2000), who to achieve response soybeans had to extend its range to 450 Gy radiation.

Plant height is high and positively related to root lodging, and the correlation coefficient was 0.97, whereas the determination coefficient was 0.96 and was highly significant. Setting both variables was increasing linear, in this way for every centimeter of height increases in the percentage of Jamaica root lodging increases by 1.11%. The root lodging in this part can be explained because the highest percentages of lodging, They were presented at plants whose height exceeds 160 cm, corresponding to low doses of gamma 5, 10 and 15 Gy radiation including the witness. The results presented here coincide with those reported by Moraima and Clarence (2003),

Table 1. Analysis of variance and multiple comparison test comparison, five variables response in roselle (*Hibiscus sabdariffa* L.), as a function of eleven levels of ^{60}Co gamma radiation. Universidad Tecnológica de Tehuacán. Cycle Summer-Autumn, 2015

Treatment	RL	GP	PH	SY	YC
Gy	%		cm	g $planta^{-1}$	
0	97.66 a	97.66 a	162.00 a	18.02 a	70.60 bc¶
5	84.00 b	95.66 a	158.33 ab	16.23 a	84.86 a
10	81.33 b	94.00 a	152.66 abc	17.16 a	83.53 a
15	82.00 b	93.33 ab	150.33 abc	15.46 ab	80.50 ab
20	80.00 b	93.00 ab	147.00 bc	17.36 a	75.46 abc
25	79.00 b	90.00 ab	142.00 c	15.70 ab	66.73 c
30	80.66 b	81.00 cd	143.00 c	15.36 ab	69.43 bc
35	54.33 c	75.00 cd	124.00 d	11.80 bc	51.43 d
40	38.00 d	79.00 cd	116.00 d	10.80 c	46.06 d
45	37.80 d	78.98 cd	110.00 d	10.00 c	46.02 d
50	37.90 d	78.00 cd	109.88 d	8.90 c	43.00 d
HSD	7.22	6.74	12.37	4.06	11.46
CV %	3.35	2.69	3.00	9.27	5.73
ANVA	**	**	**	**	**

¶Medias within columns with the same literal statistically are the same, according to Tukey $p\leq0.05$; Gy, gray; RL, root lodging; GP, germination percentage; PH, plant height; SY, seed yield; CY, calículo yield; HSD, honest significant difference; CV, coefficient of variation; ANVA, analysis of variance; ***, **, *; n.s, significant at 0.001; 0.01; 0.05 and not significant.

who mentioned that corn plants with heights exceeding 220 cm, have high degrees of it flattens that may exceed the value of 4.00, which is considered severe.

Conclusion

Based on the results obtained in this investigation, it reached the following conclusions:

- High doses of radiation 50 Gy, germination only decrease by 28%.
- The root lodging high and significantly correlated with plant height.
- The main root lodging is observed in the control and low dose gamma radiation.
- The highest yields were caliculo seed and low-dose irradiation.

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