



Phenotypic characterization of adult plants of Suico obtained from irradiated seeds

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ABSTRACT

One way to induce mutations is through irradiation with neutrons and gamma rays, which generate molecular changes. The irradiation process leaves residual radiation and creates offspring with new features. Mutations in plants can improve their performance, germination, quality, size and disease resistance. Until now the effect of the irradiation applied to native aromatic species has not been studied. On this basis, the aim of this study was to evaluate morphologically adult individuals of *Tagetes minuta* derived from seeds irradiated with neutrons and γ rays. The irradiation treatments were three: 5 and 10 hours of neutron irradiation and gamma irradiation and these were compared with plants obtained from non-irradiated seed (control). Of each treatment, 20 seedlings were placed in a field trial where completed its growth. Quantitative and qualitative phenotypic characters were evaluated. Most of the characters tested did not differ significantly among plants in different treatments. No plants with mutations of phenotypic expression, abnormalities or high mortality were recorded. From these results it can be affirmed that the species is tolerant to irradiation and can germinate and develop until complete its phenological cycle.

Keywords: irradiation, mutations, aromatic species, essential oil, *Tagetes minuta*, Asteraceae.

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Introduction

One way to induce mutations is through irradiation with neutrons and γ rays, which generate molecular changes. The variability caused by mutation induced by radiation is not essentially different from that caused by spontaneous mutations. The irradiation process leaves residual radiation and creates offspring with new features. Mutations in plants can improve their performance, germination, quality, size and disease resistance. There is not previous research about the effect of the irradiation on aromatic species native from Argentina.

The Suico (*Tagetes minuta*) is an annual aromatic herbs; it is abundant in centre and north of Argentina where 12 species of this genus are present, five of them endemic (Ariza Espinar *et al.*, 2006). Their essential oil is used in cosmetic and food industry. It has pharmacological, antimicrobial, antifungal, (Camm *et al.*, 1975; Ríos *et al.*, 1987, Figueroa *et al.*, 1995; Tereschuk *et al.*, 2002), antiviral (Babbar *et al.*, 1972) and insecticide (Boeke *et al.*, 2004; Cestari *et al.*, 2004) bioactivity. These characteristics make the Suico a very interesting species for study.

On this basis, the aim of this study was to evaluate morphologically adult individuals of *T. minuta* derived from seeds irradiated with γ rays and neutrons.

Experimental

The irradiated seeds and the control ones were obtained from a wild population of Chamental, La Rioja (Argentina). The irradiation treatments were three: 5 and 10 hours of neutron irradiation and gamma irradiation and these were compared with plants obtained from non-irradiated seed (control) (Table 1). The neutron irradiation was performed in the Nuclear Reactor RA-0 in the Facultad de Ciencias Exactas, Físicas y Naturales (Universidad Nacional de Córdoba - UNC) and the irradiation with gamma rays was carried out in a source of gamma irradiation. The irradiated seeds were placed in a growing chamber until germination, and the seedlings obtained were maintained in a greenhouse. Of each treatment, 20 seedlings were placed in a field trial in the Facultad de Agronomía (UNC), where their growth was completed. The following phenotypic characters were evaluated: height (cm), fresh and dry weight (g), number of floral branches and yield of essential oil (ml/100g), plant structure, phenology, color and density of inflorescences and mortality. The essential oil was obtained by

hydrodistillation of dry plant material. The material was distilled for 1 h using a Clevenger apparatus and then was quantified. Of each treatment, three replications were performed. The experimental design was completely randomized and the results were statistically analyzed using the software *InfoStat* (*InfoStat*, 2009). ANOVA was conducted for each of the analyzed quantitative characters and differences between means were determined using a posteriori LSD Fisher test. The qualitative characters were analyzed with chi square. In both analyses the significant level was 0.05. The homogeneity of variance assumption was not met; therefore height, fresh and dry weight values were transformed as Log10 and ANOVA was carried out on the transformed values.

Results and Discussion

None of the characters measured differed significantly among treatments. Height was measured in three moments during development and only the first measurement showed significant differences on the treatment with 5 hours of neutron irradiation ($p=0.0065$; $F=4.42$), the last two measurements was similar in all treatments ($p=0.5359$; $F=0.73$ and $p=0.6905$; $F=0.49$ respectively) (Figure 1). The fresh and dry weight did not present significant differences ($p=0.6980$; $F=0.48$ and $p=0.6471$; $F=0.55$ respectively) (Figure 2). The number of floral branches did not registered significant differences ($p=0.8986$; $F=0.20$) (Figure 3). The yield of essential oil was expressed in ml/100 g of dry plant was also similar in all treatments ($p=0.6381$; $F=0.59$).

Table 1: Identifications of three treatments and control

Treatments	
C	Control
T1	5hs of irradiation with neutrons
T2	10hs of irradiation with neutrons
T3	Irradiation with gamma rays

The qualitative characters did not present any association with either treatment of irradiation or control. The structure of plant was similar ($p=0.5717$) and the phenology was not differenced significantly ($p=0.8225$). Density of inflorescences, ($p=0.9964$); color of inflorescences ($p=0.9964$) and mortality of plants



($p=0.9294$) did not show significant differences. Most of the plants showed a structure with principal axis and few branches, also most of them begun flowering at the same time. These aspects indicate that the structure and phenology of the plant was not modified by the irradiation. No plants with mutations of phenotypic expression, abnormalities or high mortality were observed. Probably, it is still necessary a larger number of plants or higher intensity of irradiation to identify mutations.

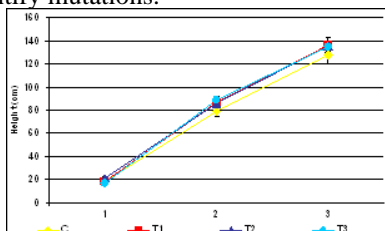


Figure 1: Height of plants in three measurements on each treatment. There were not significant differences. Bars indicate the standard error.

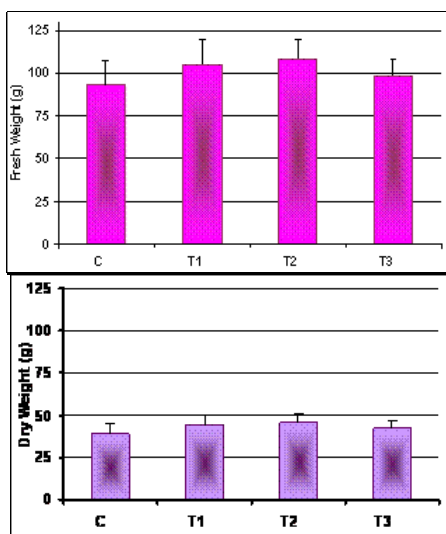


Figure 2: Average fresh and dry weight in plants of three treatments and the control. There were not significant differences. Bars indicate the standard error.

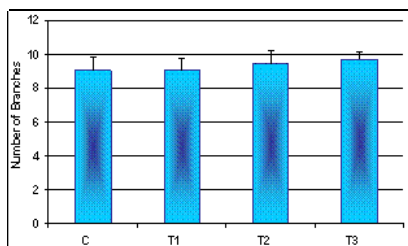


Figure 3: Average number of branches per plant in three treatments and the control. There were not significant differences. Bars indicate the standard error.

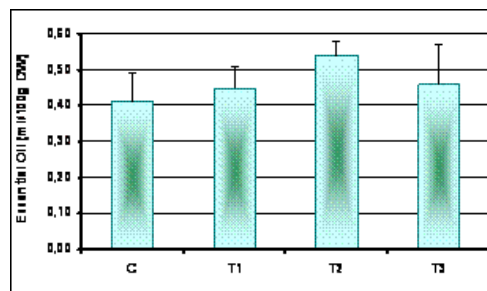


Figure 4: Average yield of essential oil in plants of three treatments and the control. There were not significant differences. Bars indicate the standard error.

Conclusions

From these results it can be affirmed that the species is tolerant to irradiation with neutrons and gamma rays and can germinate and develop to complete its phenological cycle with the fructification. The line of research will continue with the evaluation of progeny from plants selfed of each treatment in order to identify possible mutations.

Note: Part of this study was presented at the 'II Reunión de Biotecnología aplicada a plantas medicinales y aromáticas' (Second Biotechnology Meeting on Medicinal and Aromatic Plants), Córdoba, Argentina, 2009.

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