2015 International Nuclear Atlantic Conference - INAC 2015
São Paulo, S.P., Brazil,October, 04-09, 2015
ASSOCIAÇÃO BRASILEIRA DE ENERGIA NUCLEAR – ABEN
***ISBN:* 978-85-99141-05-2**

EFFECTS OF GAMMA RADIATION IN ANNATTO SEEDS

Camilo F. de Oliveira Franco[1], Valter Arthur[2], Márcia N. C. Harder[3], José C. Filho[4] , Miguel B. Neto[4], Paula B. Arthur[2]

[1]Empresa Brasileira de Pesquisa Agropecuária – EMBRAPA/EMEPA, Rodovia Ministro Abelardo Jurema, PB, 008 km 7, Jacarapé III, João Pessoa, PB., CEP 58000-000, e-mail: camilo.urucum@hotmail.com

[2]Centro de Energia Nuclear na Agricultura, CENA/USP, Universidade de São Paulo, Av. Centenário, 303, Piracicaba, SP, Brasil, CEP: 13400-970, e-mail: arthur@cena.usp.br

[3]Centro Paula Souza, Curso Superior de Tecnologia em Bicombustíveis - FATEC, Piracicaba, SP., Rua Diácono Jair de Oliveira s/n Santa Rosa, CEP 13414-141, e-mail: márcia.harder@fatec.sp.gov.br

[4]Empresa Estadual de Pesquisa Agropecuária da Paraíba – EMEPA, Rodovia Ministro Abelardo Jurema, PB, 008 km 7, Jacarapé III, João Pessoa, PB., CEP 58000-000, e-mail: jorgecazefilho@yahoo.com.br

ABTRACT

The annatto bixin has emerged as a major source of natural dyes used in the world notably by the substitution of synthetics harmful to human health and ecologic tendency in obtaining industrial products free of additives with applications in industries textiles; cosmetics; pharmaceutical and food mainly. The aim of this research was to obtain increased of germination rate and dormancy breaking on annatto seeds by gamma radiation. Annatto dry seeds were exposed to low doses of gamma radiation from source of Cobalt-60, type Gammecell-220, at 0.456 kGy/hour dose rate. In order to study stimulation effects of radiation on germination rate and dormancy breaking in the seeds. Five treatments with gamma radiation doses were applied as follows: 0 (control); 100; 125; 150 and 175 Gy. After irradiation the annatto seeds were planted as for usual seed production. According to the results obtained in this experiment we can conclude that the low doses of gamma radiation utilized on the annatto seeds did not presented significantly effect on the germination of plants. But the best dose to increase the germination of seeds was 150 Gy.
Key words: Irradiation, annatto seeds, low doses.

1. INTRODUCTION

The vegetable flora is recognized as one of the most important on the planet, featuring the greatest biodiversity of higher species. Among these, annatto (*Bixa orellana* L.) stands out for its wide applicability and ranks as one of the main sources of natural dyes used worldwide [1].

The seeds of annatto even hydrated and in temperature conditions may present temporary suspension of germination and in this situation they are dormant called [2].

The numbness of annatto seeds is a process characterized by delayed germination when the seeds even under favorable conditions (humidity, temperature, light and

oxygen) do not germinate. About two-third of tree seeds, among them is annatto, have some kind of numbness [3].

The most accurate studies of numbness checked in annatto seeds and causes to lower bixin content are very important, especially to make more profitable marketing of annatto seeds, being a product of world-wide and expressive applicability by agribusinesses.

One of the alternative methods of breaking dormancy is the use of ionizing radiation as mentioning the works of [4, 5, 6, 7, 8, 9, 10, 11] used for gamma radiation seed dormancy breaking of the various Plant varieties, some were positive, and the other obtained results that were detrimental to germination of the plants these effects being directly proportional to the increase in radiation dose. The objective of this experiment was to evaluate the effects of different doses of gamma radiation to stimulate the germination of plants annatto (*Bixa orellana* L.).

2. MATERIAL AND METHODS

Were used representative samples of annatto seeds (*Bixa orellana* L.), belonging to cultivate Piave Green Lemon, from Monte Castelo city, State of São Paulo, provided by Chr Hansen of Brazil. Samples were subjected to gamma radiation from a Cobalt-60 source, Gammacell-220 type, Atomic Energy of Canada Ltd. Ottawa, Canada, installed in the Center for Nuclear Energy in Agriculture (CENA-USP), Piracicaba, SP, under a dose rate of 0.456 Gy / hour, in the doses of 100, 125, 150, 175 Gy and control treatment. Was utilized these doses because with the smallest doses not obtained satisfactory results. The experimental design completely randomized with five treatments, each with four replications. For each treatment were used 50g annatto seeds. The experiment of seed germination was carried out in the Laboratory of Radiobiology and Environment, CENA/USP, in Piracicaba, São Paulo University.

Before being submitted to germination tests, the seeds were placed in a homogenizer, soil type separator three times in order to ensure integrity at all stages of the process. In gerboxes containing inside two sheets of blotter and to prevent loss of water by evaporation samples were kept with an ambient humidity above 90%, to reduce the need for re-wetting of the seeds after sowing. Previously against the action of pathogens was used Cercobin 700 WP fungicide, systemic at a ratio of 1g / kg of seed. 60 seeds were placed per treatment and four replications for each germinated in a germination chamber BOD at a constant temperature of 28° C for a period of 15 days.

The seventh day, obeying the rules of seed analysis (Brazil, 2009), the gerboxes were taken from the germination, aiming to carry out first count of germination. Computed numbers, gerboxes were led back to the germination chamber, remaining there for seven days when we were done the second and final count of germination of annatto seeds.

It was considered germinated the seeds that presented the issue of rootlets. Data were subjected to analysis of variance (ANOVA), using the F test at 5% probability level for comparison of treatment means.

3. RESULTS AND DISCUSION

The data shown in Table 1 demonstrate that the behavior of the annatto seed germination, growing Piave Green Lemon, count shows the same trend. It is observed that there was no significant difference (P> 0.05) between treatments (Gy doses) on the percentage of seed germination, indicating that radiation Cobalt-60 range did not influence the dormancy of this cultivar break. Although treatments do not differ, there was a tendency on the increase in the breaking of dormancy, especially to the gamma radiation doses of 125 and 150 Gy. We can observe that the radiation dose 150 Gy promoted dormancy breaking, but with values similar to those obtained by the treatment control.

Table 1. Annatto seed germination average values *Bixa orellana* L. irradiated with increasing doses of gamma radiation from Cobalt-60.

Doses/Gy	Irradiated Seeds	Germinated Seeds	Germinated Porcentage
0 (control)	60	36.0a*	60.0
100	60	34.0a	58.0
125	60	37.0a	62.0
150	60	42.0a	67.0
175	60	34.0a	58.0

*Means by same letters do not differ significantly at Tukey (P> 0.05)

The results of this experiment are similar the other studies with gamma radiation to increase the germination to other species such as corn, soybeans and sunflowers, [6,7,8]. However, the results obtained [12] when evaluating the effects of different doses of gamma radiation and concluded that the seeds irradiated with doses of 100 Gy and 200 showed a slower germination when compared to the control, since the doses of 300, 400 and 500 Gy caused complete inhibition of germination

4. CONCLUSION

Gamma radiation in the doses used did not significantly influence the annatto seed germination grow Piave Green Lemon. But the best results in germination of annatto seeds was at a dose of 150 Gy.

REFERENCES

1. Franco, C. F. O; Fabri, G. E.; Neto, M. B.; Manfiolli, H.M.; Harder, M. N. C.; Rucker, N. C. de A. *Urucum Sistema de Produção para o Brasil*. João Pessoa, PB: Emepa, 2008. 112p.
2. Bewley, J. D.; Black, M. *Physiology and biochemistry of seed in relation to germination.* Berlim: Springer Verlag, 1994. 375 p.
3. Amaral, L. I. V.; Pereira, M. F. D. A; Cortelazzo, A. L. Germinação de sementes em desenvolvimento de *Bixa orellana*. *Revista Brasileira de Fisiologia Vegetal,* São Paulo, SP**, v. 12**, n. 3, p. 273-285, 2000
4. Luckey, J. *Hormesis with ionizing radiation*. Flórida: CRC Press, 1980. 4p.
5. Harder, M.N.C.; Guedes, B.; Arthur, V.; Silva, L.C.A.S.; Franco, C.F.O. Uso da radiação gama para a quebra de dormência de urucum em ambiente controlado. *Ecossistema* (UniPinhal), **v.33**, p. 31-34, 2008.
6. Crede, R.G.; Baldasso, J.G.; Claudio, T.B.; Fanaro G.B.; Guedes, R.L..; Sabundijan, I.T.; Villavicencio, A.L.C.H. Germinometria de grãos de milho (*Zea mays*) e soja (*Glicine* Max) tratados por radiação ionizante. *Arquivo do Instituto de Biologia*, **v.71** (supl.), p. 189-191. 2004.
7. Fanaro, G.B.; Baldasso, J.G.; Crede, R.G.; Claudio, T.B.; Sabundjian, I.T.; Guedes, R.L.; Villavicencio, A.L.C.H. Teste de germinação em sementes de girassol (*Helianthus annus* L.) irradiadas. *Arquivo do Instituto de Biologia*, **v.71** p.178-180. 2004.
8. Barros, C. A. ; Arthur, V. . Determinação experimental da dose de redução do crescimento (GR50) e da dose letal (LD50) de soja irradiada por raios gama.. Arquivos do Instituto Biológico (Impresso), São Paulo, **v. 72**, n.2, p. 19-26, 2005.
9. Polizel, F.F.; Arthur, V.; Harder, M.N.C.; Franco, C.F.O. Influência da radiação gama no poder germinativo de sementes de urucum. In: *19° SIICUSP*, 2011, Piracicaba. Anais 19° SIICUSP, 2011.
10. Wiendl, T. A. *Efeitos de baixas doses de radiação gama do Co-60 (Radio-hormesis) em sementes de tomate*. 2010. 71 p. Tese (Doutorado em Radiobiologia)- IPEN. São Paulo, SP, 2010.
11 .Santos, T.S.A.; Suassuna, F.A.C.; Coutinho, T.M.F.; Wirton, M.; Poline, B.A. Resposta de sementes de amendoim a diferentes doses de radiação gama (Co-60). *Revista Brasileira de Engenharia Agrícola e Ambiental*, **v. 14** (10), 1074-1078. 2010.