



PRESERVATIVE SOLUTION FOR GAMMA IRRADIATED CHRYSANTHEMUM CUT FLOWERS

OLIVIA KIMIKO KIKUCHI*, NELIDA LUCIA DEL MASTRO*,
and
FREDERICO MAXIMILIANO WIENDL**

*IPEN-CNEN/SP - Industrial & Engineering Application Coordination
cx. postal 11049 - São Paulo-SP - 05422-970

**CENA - Nuclear Energy Center for Agriculture - University of São Paulo
cx. postal 96 - Piracicaba, SP - 13400-970
BRAZIL

ABSTRACT

Yellow mini-chrysanthemums were irradiated in a Cobalt-60 Gammacell at the dose of 900 Gy (467 Gy/h) one day after harvest. Samples of 50 flowers, partially opened buds were used to estimate the flower viability. Aluminum sulfate and 8-hydroxyquinoline sulfate were used as two preservative solutions aiming to protect the cut flowers. Our results indicated that the stem immersion in the preservative solutions before and after the irradiation treatment was an efficient procedure, stimulating the flowers development and maintaining the vase-life almost as long as the controls. The present work concludes that it would be possible to use preservative solutions to minimize the damaging effects of the ionizing radiation on chrysanthemum cut flowers, maintaining at the same time the disinfection action of radiation processing.

KEYWORDS: Chrysanthemum flowers; ionizing radiations; preservative solutions.

INTRODUCTION

Fresh cut flowers and ornamental plants, specially for exportation purposes, are required to be disinfested to prevent the introduction of new plagues within the importing countries. Brazil has a huge diversity of plants and an increasing horticultural development directed to international trade. However, the actual chemical procedures currently used for disinfection are potentially harmful against the workers and the environment. On the other hand, those methods are sometimes inefficient as a consequence of the flowers pattern itself. This way, the potential of irradiation technology in insect control has been widely demonstrated. A flower is a plant reproduction element relatively sensitive in relation to ionizing radiations. The damage caused by ionizing radiation in cut flowers are described as colour changes in petals and leaves; vase-life shortening; wilting; petals and leaves scorching and bud opening failure (Wit & Van de Vrie, 1985). Chrysanthemum cut flowers have their vase-life shortened and can present leaves chlorosis and scorching after irradiation (Tanabe & Dohino, 1993; Wit & Van de Vrie, 1985). The 8-hydroxyquinoline salts have antiseptic properties and have been used in association with sucrose and other chemicals to extend the cut flowers vase-life (Rogers, 1973). The aluminum sulfate is suggested as a less expensive substitute of the 8-hydroxyquinoline, being successfully used in *Protea* (Haasbroek et al., 1973) and gladiolus cut flowers (Rameshwar, 1974).

The present work demonstrates that it is possible to use low cost preservative solutions to minimize the damaging effects of the ionizing radiations on chrysanthemum cut flowers, maintaining at the same time the disinfection action of the radiations.

MATERIALS AND METHODS

The flowers of yellow mini-chrysanthemums were obtained one day after harvested, proceeding from near Mogi das Cruzes, a city about 63 km away. The stems were cut down to approximately 18 cm and distributed as follows: control - soaked into distilled water; 900 Gy - irradiated and soaked in distilled water; 900 Gy + AlSO₄ - irradiated and soaked into aluminum sulfate preservative solution; 900 Gy + 8-HQ - irradiated and soaked into 8-hydroxyquinoline sulfate preservative solution; AlSO₄ - soaked into aluminum sulfate preservative solution and; 8-HQ - soaked in 8-hydroxyquinoline sulfate preservative solution. Each group was composed of 50 partially opened flowers buds. They were soaked into distilled water or in preservative solutions during 3.5 hours before irradiation. Preliminary tests were realized to establish the best concentration of the preservative solutions: Aluminum sulfate solution - AlSO₄ -modified from Haasbroek (1973):- 0.025% maleic hydrazide - 0.001% aluminum sulfate - 0.01% citric acid - 0.01% hydrazine sulfate- 2% sucrose - 0.0025% silver nitrate - 8-hydroxyquinoline sulfate solution - 8-HQ modified from Schoenmaker (personnal communication): - 0.01% 8-hydroxyquinoline sulfate - 2% sucrose - 0.01% citric acid and - 0.0025% silver nitrate. The cut flowers irradiation was performed within a Cobalt-60 Gammacell source with the dose of 900 Gy (467 Gy/h), without the stems soaked into any solution, but only in plain water. After irradiation they were again soaked. During the experiments the room temperature varied from 20 to 25° C. The solutions were changed only once, 5 days after irradiation. The flowers diameters were measured at the beginning of the the experiment and on the 3rd, 7th, 10th and 14th day after irradiation. The flowers were considered lost when they becoma wilted and or the leaves showed considerable colour changes.

RESULTS AND DISCUSSION

The factor of the cut flowers shelf life shortening has many causes. The treatment with the dose of 900 Gy of gamma radiations was the most damaging, accelerating the senescence of the flowers and of the leaves. The preservative solutions were able to maintain the leaves green (AlSO₄ and 8-HQ samples). For protecting the irradiated flowers, this solution was the most efficient, but not so efficient to maintain the leaves green. The leaves deteriorated first on the treatment by irradiating the flowers with 900 Gy + AlSO₄ and 900 Gy + 8-HQ. The vase-life of the flowers on these two irradiation treatments was almost the same as the controls, 9 and 10 days respectively, due to the effective action of the preservative solutions (Table 1).

Table 1. The main causes of the chrysanthemum cut flowers non viability and their vase-life.

sample	causes of non viability	vase life (days)
control	leaves yellowing	10
900 Gy	leaves yellowing and blackening, flowers wilting	5
900 Gy + AlSO ₄	leaves yellowing and blackening	9
900 Gy + 8-HQ	leaves yellowing and blackening	9
AlSO ₄	flowers wilting	14
8-HQ	flowers wilting	14

The free radicals that normally are produced during the irradiation of biological systems could be responsible for the senescence acceleration observed in the cut flowers. It is known that free radicals of oxygen can damage lipids, proteins, carbohydrates and nucleic acids, whose injurious effects may be minimized by scavengers (Monk *et al.*, 1989). Indeed, Droillard *et al.* (1987) observed that there is an increase in the free radical level during the flower withering of cut carnations. The preservative solutions

used in our experiments do not contain radical scavengers, but the sucrose is a good energy supply and probably contributed to equilibrate the cell metabolism, increasing the defense against damages. The diameter enlargement of the flowers was more evident in the partially opened buds. The minimum diameter increased during the vase-life, mainly in the preservative solutions treated samples. The process was blocked in the flowers irradiated with 900 Gy, but the others showed a sensible increase during the first three days until the 7th day. The number of flowers contributing to the diameter enlargement was high on all preservative solutions treated samples but low in the group treated with 900 Gy of gamma radiations. As the maximum diameter did not change considerably, the general enlargement was mainly due to the increase of the partially opened buds and the developing flowers. The flowers diameter enlargement between 1 and 5 mm was the most frequent, except of the flowers irradiated with 900 Gy. The diameter of the flowers treated with preservative solutions increased more than the control ones and some irradiated and preservative solution treated flowers continued developing, reaching enlargement size between 11 and 15 mm. In the literature a generic dose of 300 Gy of ionizing radiation was established to be effective for quarantine security against any stage of any arthropod pest (Loaharanu, 1992). This considering the treatment efficacy based on the non ability to perpetuate the species, instead of irradiating the insects until their individual death (Heather, 1992). However, to assure that all the insects were irradiated with the minimum dose of 300 Gy it would be necessary to irradiate the whole cut flowers packages with higher doses. For this we used the dose of 900 Gy, whose damaging effects on the chrysanthemums could be minimized by the use of preservative solutions, avoiding the wilting of the flowers when they were soaked before and after irradiation. The hydroxyquinoline sulfate, more expensive, can be substituted by aluminum sulfate.

REFERENCES

- Droillard, M.J.; Paulin, A. and Massot, J.C. (1987). - Free Radicals Production, Catalase and Superoxid Dismutase Activities and Membrane Integrity During Senescence of Petals of Cut Carnations (*Dianthus caryophyllus*). *Physiol. Plant.*, 71, 197-202.
- Haasbroek, F.J.; Rousseau, G.G. and de Villiers, J.F. (1973). - Effect of Gamma Rays on Cut Blooms of *Protea compacta*, *P. longiflora* Lamarek and *Leucospermum cordifolium* Salisb. ex Knight. *Agroplantae*, 5, 33-42.
- Heather, N.W. (1992). - Review of Irradiation as a Quarantine Treatment for Insects other than Fruit flies. *In: Use of Irradiation as a Quarantine Treatment of Food and Agricultural Commodities* (International Atomic Energy Agency, Ed.), pp. 203-218, Proceedings of the Final Research Co-ordination Meeting, Kuala Lumpur, Malaysia, 27-31 August 1990.
- Monk, L.S.; Fagerstedt, K.V. and Crawford, R.M.M. (1989). - Oxygen Toxicity and Superoxide Dismutase as an Antioxidant in Physiological Stress. *Physiol. Plant.*, 76, 456-459.
- Loaharanu, P. (1992). - Review: Coordinated Research Programme on Use of Irradiation as a Quarantine Treatment of Food and Agricultural Commodities. *In: Use of Irradiation as a Quarantine Treatment of Food and Agricultural Commodities* (International Atomic Energy Agency, Ed.), pp 1-5, Proceedings of the Final Research Co-ordination Meeting, Kuala Lumpur, Malaysia, 27-31 August 1990.
- Rameshwar, A. (1974). - Aluminum Sulfate, a New Preservative for Cut Flowers. *Indian J. Hort.*, 31(1), 95-96.
- Rogers, M.N. (1973). - An Historical and Critical Review of Postharvest Physiology Research on Cut Flowers. *Hortscience*, 8 (3), 189-194.
- Tanabe, K. and Dohino, T. (1993). - Effects of Electron Beam Irradiation on Cut Flowers. *Res. Bull. Pl. Prot. Japan*, 29, 1-9.
- Wit, A.K.H. and Van de Vrie, M. (1985). - Gamma Radiation for Post Harvest Control of Insects and Mites in Cut Flowers. *Med. Fac. Landbouww. Rijksuniv. Gent.*, 50/2b, 697-704.