Results of EEG project 04-042, Contract TSD-A-188

RIKILT project 404.0740

Application of food irradiation processes to developing countries.

Project leader: D.Is. Langerak

Report: 88.80 December 1988

Preliminary study on the effect of combined treatment of hot air and irradiation on the control of neck rot in onions infected with Botrytis spp

By: Langerak D.Is.; Th.C. Wolters; V.H. Quan.

Approved by: Dr.Ir. L.H.M. Vroomen

State Institute for Quality Control
of Agricultural Products (RIKILT)
Bornsesteeg 45, 6708 PD Wageningen
P.O. Box 230, 6700 AE Wageningen
Telephone (0)8370 - 19110
Telex 75180 RIKIL
Facsimile (0)8370 - 17717

SENDING LIST

INTERNAL:
director
divisionstaff
project leader
department food irradiation
circulation
library

EXTERNAL:
Management Agricultural Research (DLO)
Management Food Quality Matters (VKA)
Agralin
Ministery of Agriculture and Fisheries
Office Information on Food

ABSTRACT

Preliminary study on the effect of combined treatment of hot air and irradiation on the control of neck rot in onions infected with Botrytis spp

Report 88.80 December 1988
Langerak D.Is.; Th.C. Wolters; V.H. Quan*.

State Institute for Quality Control of Agricultural Products (RIKILT), P.O. Box 230, 6700 AE Wageningen, the Netherlands.

* Vietnam National Atomic Energy Institute 67 Nguyen Du, Hanoi, Vietnam.

4 figures, 2 tables, 18 references.

Onions are one of the most widely used condiments because of its characteristic odour and flavour. The losses are mainly due to sprouting and mould attack. The aim of this experiment is to investigate the effect of a combined treatment of heat and irradiation on the control of neck rot in onions.
The onions were artificially infected with Botrytis spp and treated, for 35 min, with moist air of 20, 45 and 50 °C, 99% relative humidity. The onions were irradiated at doses of 0, 0,1, 0,5 and 1,0 kGy within half an hour after the heat treatment in order to achieve a synergistic effect.
It proved from the results that a heat treatment of 50 °C combined with an irradiation dose of 0,1 kGy gave the best results.

Key words: Botrytis aclada, bulb products, combined treatment, heat treatment, irradiation, mould, neck rot, onions, sprout inhibition

( )

( )

CONTENT Page

1 INTRODUCTION

Onions are one of the most widely used condiments due to its characteristic odour and flavour. This condiment is needed throughout the year, but the spoilage of onions which is due to sprouting and microbial attack presents a serious problem when the commodies are stored under ambient temperatures (25 to 35 ^{o}C) pervailing during most of the year in tropical and sub-tropical countries (Sreenivasan 1973).
Microbial decay may partly be prevented by using fungicides before and after harvest. The use of fungicides, however, increases the chemical burden of onions. This is probably the reason why chemicals have not been widely used for sprout and mould control. Cooling delays mould infection but does not prevent it.
Since 1950, irradiation has been applied to inhibit sprouting and to prevent attack of mould in onions (Dallyn et al. 1955, 1956, Hannan 1958, Sawyer & Dallyn 1956, Metlitsky et al. 1968, Mahmoud et al. 1977). With onion bulbs, the overdose brings about an increase in rotting and losses due to softening, and sometimes the acceleration of sprouting or transistory stimulation of sprouting (Mullins & Burr 1961, Nair et al. 1972). Therefore it is necessary to discover a means of lessening the natural effect of radiation on irradiated onions.
Heat treatment of food is a well established and accepted method of processing food for consumption. An alternative treatment to prevent mould infection is the application of heat or irradiation, however, for an effective control, a heat treatment higher than 55 ^{o}C or an irradiation dose of more than 2 kGy is necessary. Both treatments cause damage to the skin or tissue of the commodity. For this reason the combination of a low irradiation dose combined with a mild heat treatment is one of the methods which is the most effective on preventing this disadvantagous changes (Langerak 1986).
The synergistic effect of heat and radiation, its kinetic pays a role in improving the keeping quality of onions. However, the mechanism of synergistic effect of heat and irradiation is now not clear (Grecz et al. 1981).
Some investigators proved that a heat treatment combined with an irradiation treatment on different objects was more effective than both treatments alone as well as the sum of both treatments (Islam et al.

1985, Kiss & Clarke 1969, Langerak & Canet-Prades 1979, Padwal-Desai et al. 1973, Roy et al. 1972, Summer et al. 1972). None of these publications have discussed this problem for onions.
In relation to above mentioned problem the following research have been set up with the aim control of neckrot on onions caused by Botrytis aclada spp under combined treatment of hot air and irradiation.

2 MATERIALS AND METHODS

2.1 Sample preparation

The sample material have been received from a local firm in the Netherlands. The onions were stored at 4 °C, 90% relative humidity for about 2 month before the experiment was carried out. Before they were used in the experiment, the injured and deseased onions were removed. From a number of rotten onion bulbs mould spores of Botrytis spp were collected. From these spores, a spore suspension of approximately 2 x 10^5 spores.ml^{-1} was made. The onions were artificially infected as follows.
On two sides of the onion bulbs a hole was made of 5 mm diameter and approximately 2 mm deep. To each hole 0,050 ml of the spore suspension was added. The samples were incubated for 48 hours at 20 °C, 95% relative humidity.
The samples were subsequently placed into a climate chamber at 20, 40, 45 and 50 °C, 99% relative humidity, till the surface of the onions had reached the same temperature of the environment. The temperatures were measured with the help of thermocouples. Within 30 min after treatment the samples were irradiated with doses of 0, 0,1, 0,5 and 1,0 kGy. The samples were stored at 20 °C, 90 to 95% relative humidity.

2.2 Rot incidence

In order to estimate the percentage of decay during the storage the product was sorted in 2 groupes: 1. Onions which showed a clear mould growth in the hole, but no softening of the tissue, were considered as moulded; 2. Onions which showed softening were counted as rot. Onions

which showed mould or rot diseases were not removed from the experiment assuming that in the practice also rotten bulbs will not be removed from a storage room. On the end of the storage period all onions were cut in order to check the rot incidence.

3 RESULTS AND DISCUSSION

The effects of combined treatment of heat and irradiation on the mould growth and rot incidence are presented in table 1 and figures 1 to 4. From the results it showed that a heat treatment decreases the mould growth and rot incidence with increasing temperature. Irradiation with 0,1 kGy did not have an effect on the mould growth and rot incidence whereas irradiation with 0,5 and 1,0 kGy seemed to have a negative effect probably due to the disturbance of the native resistance mechanism of the onion bulbs.

The combination of heat and irradiation, however, showed a synergistic effect on the control of mould or rot. The best results, in this experiment, were obtained with the combination heat at 50 ^{o}C and irradiation with 0,1 kGy. The applied combination was, however, not enough to prevent completely the decay.

The experiment was carried out on the end of the storage period. The product was quickly used up. The following experiments have to be carried out just after harvest, expecting better results.

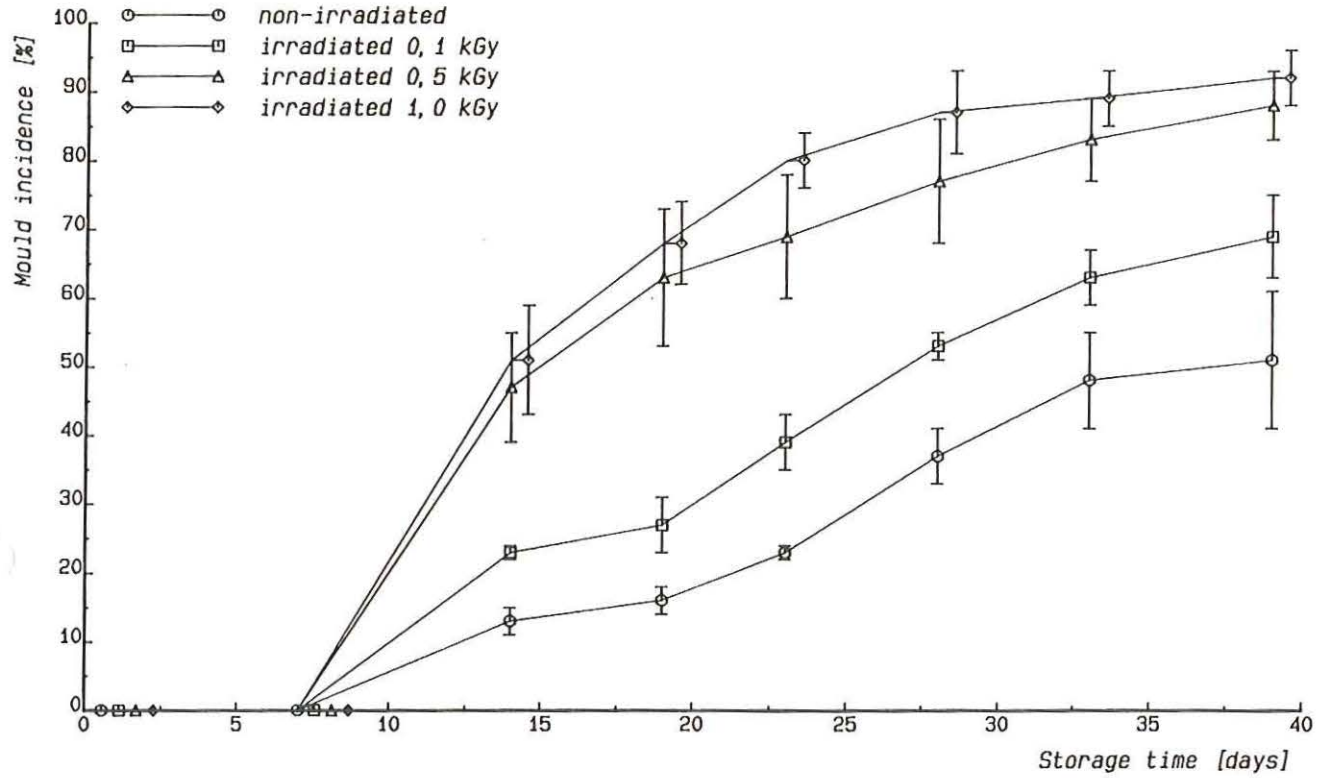

Figure 1: Average percentage of moulded spots ± SE of 3 samples onions infected on two sides with Botrytis spp, heat treated at 20 °C, irradiated and unirradiated and stored at 20 °C.

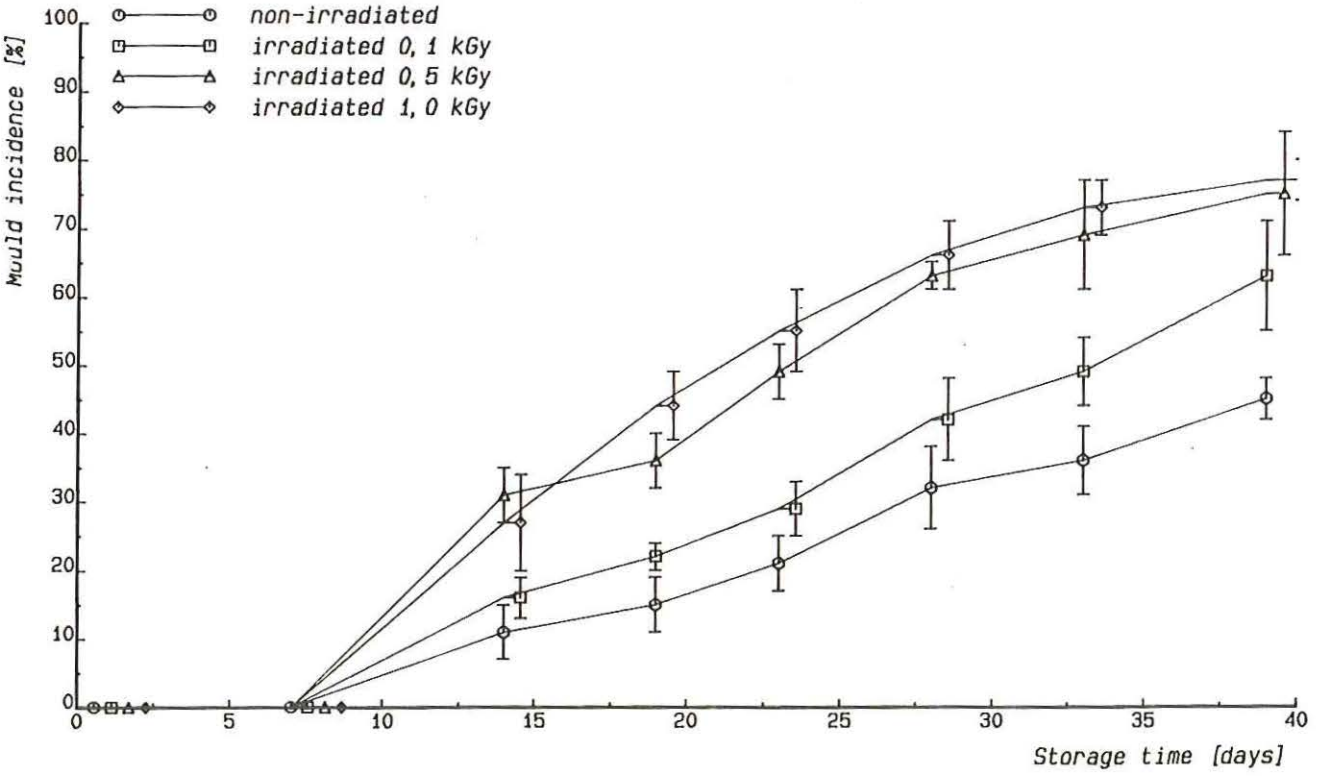

Figure 2: Average percentage of moulded spots ± SE of 3 samples onions infected on two sides with Botrytis spp, heat treated at 40 °C, irradiated and unirradiated and stored at 20 °C.

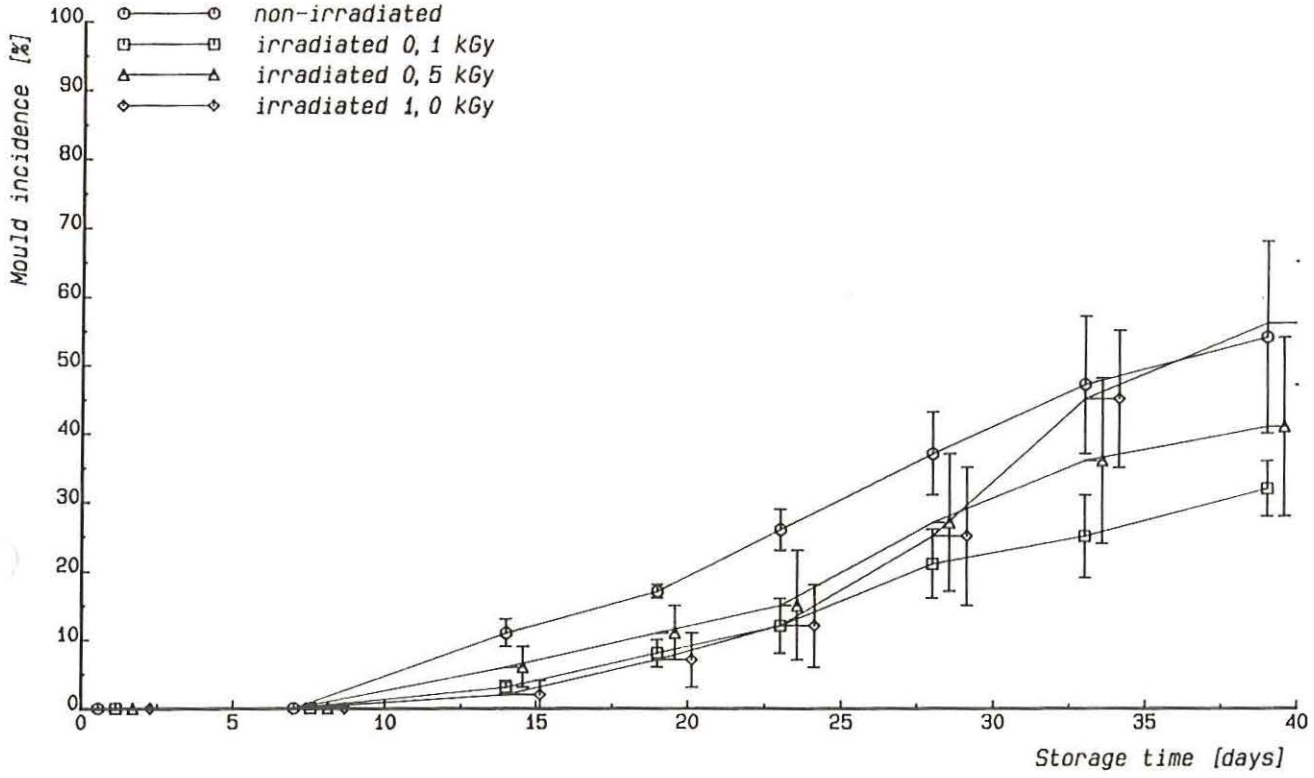

Figure 3: Average percentage of moulded spots ± SE of 3 samples onions infected on two sides with Botrytis spp, heat treated at 45 °C, irradiated and unirradiated and stored at 20 °C.

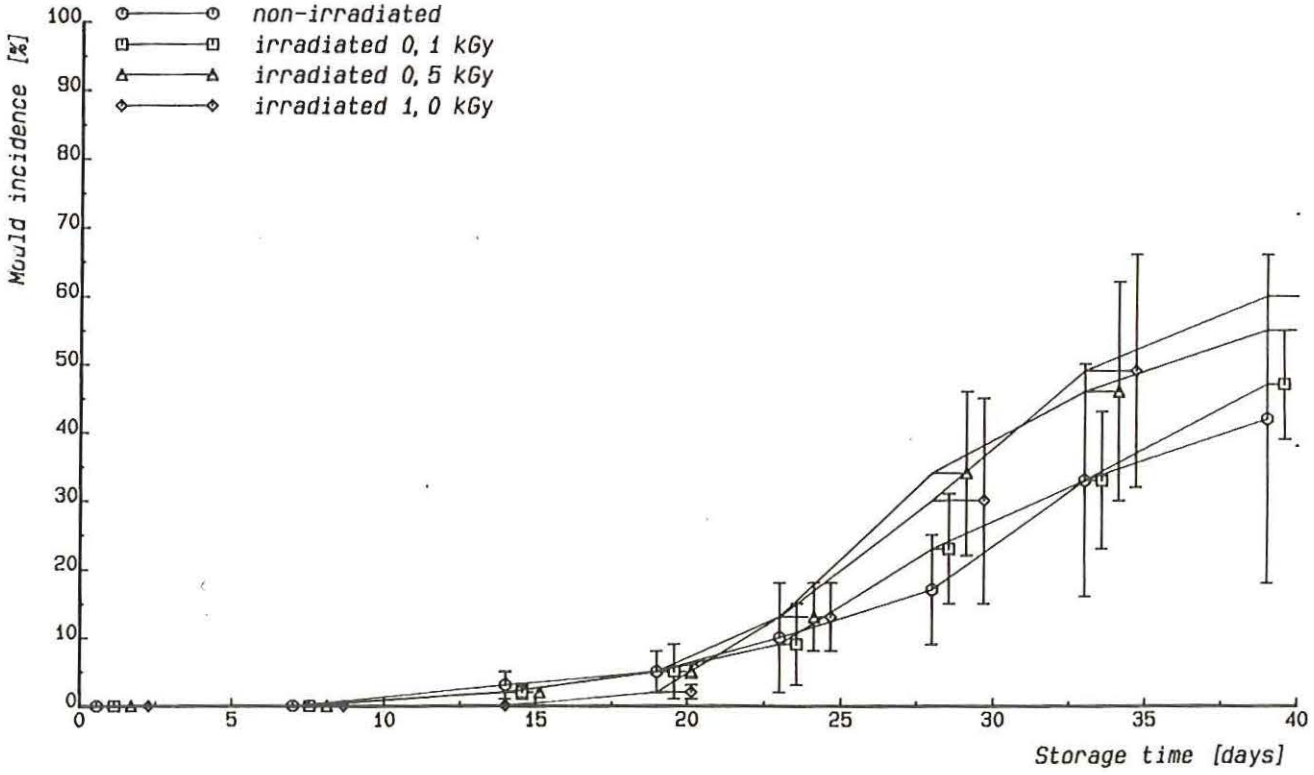

Figure 4: Average percentage of moulded spots ± SE of 3 samples onions infected on two sides with Botrytis spp, heat treated at 50 °C, irradiated and unirradiated and stored at 20 °C.

Table 1: Average percentage of rotten spots ± SE of 3 samples of 25 onions infected on two sides with Botrytis spp, heat treated at different temperatures, irradiated and non-irradiated and stored at 20 °C.

storage [days]	irradiation dose [kGy]	heat treatment [°C] 20	40	45	50
0	0	0	0	0	0
	0,1	0	0	0	0
	0,5	0	0	0	0
	1,0	0	0	0	0
39	0	45 ± 8	51 ± 9	48 ± 7	25 ± 12
	0,1	52 ± 17	51 ± 5	25 ± 5	11 ± 3
	0,5	76 ± 17	65 ± 10	17 ± 8	22 ± 10
	1,0	85 ± 5	71 ± 7	39 ± 12	23 ± 15

4 CONCLUSIONS

A heat treatment alone of 50 °C has a positive effect on the prevention of mould growth and rot incidence.

An irradiation dose up to 1 kGy is not enough to kill Botrytis spp.

A combination treatment of heat at 50 °C with irradiation using 0,1 kGy, applied within the dormancy period, prevents sprouting and reduces mould growth and neck rot.

REFERENCES

Dallyn S.L.; R.L. Sawyer; A.H. Sparrow.
Extending onion storage life by gamma irradiation.
Nucleotics 13, 1955, p48.

Dallyn S.L.; R.L. Sawyer; A.H. Sparrow.
Effect of sprout inhibition levels of gamma irradiation on the quality of onions.
Proc. Amer. Soc. Hort. Sci. 73, 1956, p398

Grecz G.; G. Bruszer; I. Amin.
Effect of radiation and heat on bacterial spore DNA.
Combination process in food irradiation.
Proc. Symp. Colombo 24-28 Nov. 1980. IAEA, Vienna, 1981, p3

Hannan,L.S.
Research on science and technology of food preservation by ionizing radiation.
Chem. Publ. Co. Inc. New York.

Islam M.S.; D.Is. Langerak; Th.C. Wolters; A. Hassan.
The effect of combined treatment of heat and irradiation, and the combination of different chemicals and irradiation on rot in potatoes stored at 20°C, 90% RH and 15°C, 90% RH.
IFFIT report 59, 1985.

Kiss I.; D.I. Clarke.
A study of the death of yeast upon heat treatment, irradiation and combination of both.
Elelmiszertudomany, 3(2), 1969, p115

Langerak D.Is.; F.M. Canet-Prades.
The effect of combined treatment on the inactivation of mould in fruit and vegetable.
Techn. and Prelim. Res. Report 88.
ITAL, Wageningen, the Netherlands, 1979.

Langerak D.Is.; M.D.A. van Duren.
Effect of combined treatment on the quality of some commodities stored under laboratory and practical conditions.
Techn. and Prelim. Res. Report 100.
ITAL, Wageningen, the Netherlands, 1983.

Langerak D.Is.
Combined heat and irradiation treatments to control mould contaminations in fruits and vegetables.
Lecture IFFIT training course.
RIKILT, P.O. Box 230, 6700 AE Wageningen, the Netherlands 1986

Mahmoud A.A.; B. Kalman; J. Farkas.
A study of some chemical changes in onion bulbs and in their inner bids as affected by gamma radiation and storage.
IAEA/FAO/WHO Int. Symp. Food Pres. Irr.
IAEA SM-221/22 Wageningen, the Netherlands, 1977.

Metlitski,L.V.; Rogacher,V.N.; Krushcher,V.G.
Radiation processing of food products, Moskow 1967.
Eng. transl. ORNL-UC-14 Oak Ridge National Laboratories 1968.

Mullins W.R.; H.K. Burr.
Treatments of onions with gamma rays: effects of delay between harvest and irradiation.
Food Technol. 15, 1961, p178.

Nair P.M.; P. Thomas; K.K. Ussuf; K.K. Surendranathan; S.P. Limaye; A.N. Srirangarajan; S.R. Padwal-Desai.
Studies of sproutinhibition of onions and potatoes and delayed ripening of bananas and mangoes by gamma irradiation.
Rad. Pres. of Food. Proc. symp., Bombay, 1972.
IAEA SM-166/11, Vienna, 1972, p347.

Padwal-Desai S.R.; A.S. Chanekar; R. Thomas; A. Sreenivasan.
Heat radiation combination treatment for control of mould infection in harvested fruits and processed cereal foods.
Acad. Sci. Hung. 2, 1973, p23.

Roy K.; M.S. Chateth; P.M. Murewar.
Gamma irradiation in the extension of shelf life of apples infected with Aspergillus niger Van Tiegham.
Phytopathol. zeitschrift, 75, 1972, p31.

Sawyer R.L.; R.L. Dallyn.
Vaporized chemical inhibition and irradiation. Two new methods of sprout control for tuber and bulb crops.
Proc. Amer. Soc. Hort. Sci. 67, 1956, p 514.

Sreenivasan A.
Improvement of food quality by irradiation.
Proc. Panel, IAEA, Vienna, 1973, p129.

Summer N.F.; R.J. Fortlage; P.M. Buckely; E.C. Maxie.
Cooperative sensitivity to gamma radiation of conidia mycelia and selerolia of Botrytis cinerea.
Radiation Botany, 12, 1972, p99.