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המכון הלאומי והאוניברסיטאי לחקלאות

THE NATIONAL AND UNIVERSITY INSTITUTE OF AGRICULTURE  
DEPARTMENT OF FOOD TECHNOLOGY  
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STORAGE EXPERIMENTS ON GRAPES FOR EXPORT (1961)

Influence of Various Shelf-Life Conditions  
After Storage on the Development of Rots

By

Rivka Barkai-Golan and S. Angel Malachi



המחלקה לפירסומים

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Influence of Various Shelf-Life Conditions  
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Concurrently with the experiments on comparison of efficiency of various treatments with  $\text{SO}_2$ -emanating tablets, tests were made to determine the influence of various shelf-life conditions after storage on the development of rots of stored fruit.

The experiments were carried out on the same varieties as in the above mentioned experiments, and included "Queen of the Vineyards", ("Malkat Hakramim") "Alphonse Lavallée" "Waltham Cross" ("Tamar Beyrouti") and "Sultanina" (Thompson Seedless).

M E T H O D S

Queen of the Vineyards, Alphonse Lavallée and Waltham Cross were packed in South African boxes, and Sultanina was packed in Cyprus trays.

Treatments included 5 grams of  $\text{K}_2\text{S}_2\text{O}_5$  powder per S. African box, and 10 grams per Cyprus tray. Controls included untreated boxes and trays for each variety tested.

After 3 weeks at  $0^\circ\text{C}$ , packed boxes and trays of grapes were placed simultaneously at room temperature ( $25^\circ\text{C}$  average), and at  $17^\circ\text{C}$  for 2, 4, 7 or 9 days shelf-life.

## RESULTS AND CONCLUSIONS

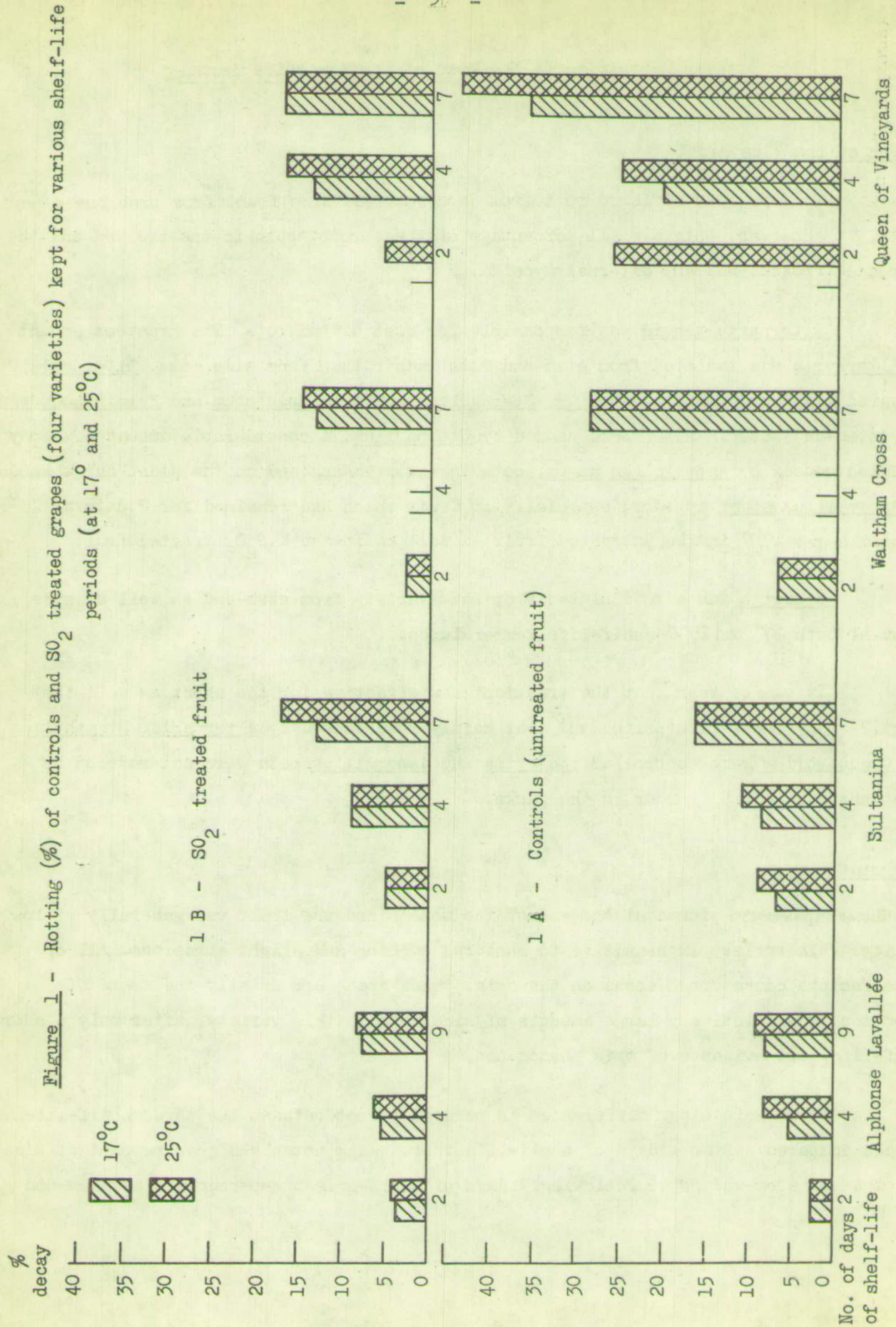
Comparing the untreated fruit for the four varieties, we found that Alphonse Lavallée was the most resistant to decay; this agrees with the results of the experiments with  $\text{SO}_2$ -emanating tablets. After 9 days at  $25^\circ$ , decay in Alphonse did not rise above 8%. The variety most susceptible to decay was Queen of the Vineyards which was also as in the above mentioned experiment. After a shelf-life of 7 days at  $25^\circ\text{C}$ , there was over 40% decay in this variety.

Waltham Cross and Sultanina were intermediate in percentage of rot which developed. In Waltham Cross there was 30% rot after 7 days at  $25^\circ\text{C}$ , and in Sultanina 17%. Alternaria tenuis was the most widespread causal agent of decay among the four varieties tested, which is in agreement with results from previous years' experiments (2,3).

A comparison of percentage of rotting between treated and untreated fruit at both shelf-life temperatures,  $17^\circ$  and  $25^\circ\text{C}$ , generally showed a somewhat lower percentage of rotting in the fruit kept at  $17^\circ\text{C}$ . For all varieties a notable increase in percentage of rotting was due not to the temperature difference between  $17^\circ$  and  $25^\circ\text{C}$ , but to the lengthening of the shelf-life. A shelf-life of four days at  $25^\circ\text{C}$  usually brought about an equal or even lower percentage of rotting than a longer shelf-life of 7 days at  $17^\circ\text{C}$  (see Fig. 1).

Fig. 1 also shows the reduction in percentage of rotting caused by the  $\text{K}_2\text{S}_2\text{O}_5$  treatment. This reduction occurred at both shelf-life temperatures. The influence of the treatment was often more apparent in fruit kept at  $25^\circ$  rather than at  $17^\circ\text{C}$ , and in fruit kept for the longest period of shelf-life.

These results also show that the relative effectiveness of the treatments rose as the percentage of decay rose in the fruit.



Details Pertaining to the Rots of the Varieties Tested

Queen of the Vineyards

This variety suffered most from decay, as was also found from previous experiments. However, only a small percentage of these rots, both in the treated and the untreated fruits, had any external mycelia.

Alternaria tenuis was responsible for most of the rots. The greatest amount of Alternaria was isolated from stem-end rots rather than from side rots. Alternaria appeared alone or with Cladosporium, Stemphylium and even Epicoccum and Helminthosporium. Many stem-end rots in Queen were caused by Stemphylium. A considerable amount of decay was also caused by Aspergillus niger, both in the stem-end and on the side. Large amounts of Aspergillus niger appeared especially in fruit which had remained for 7 days at 25°, as well as at 17°C, in the untreated fruit as well as in the  $K_2S_2O_5$  treated fruit.

Botrytis was also isolated from this variety from stem-end as well as side rots, at both 17° and 25°C shelf-life temperatures.

It can be seen that the treatment was effective for the short as well the long (7 days) shelf-life period and that mainly rots caused by Alternaria, Stemphylium and Cladosporium were controlled. Botrytis and Aspergillus rots were not reduced by treatment with  $K_2S_2O_5$  powder in the packs.

Waltham Cross

The grapes were picked at the end of the season and the fruit was generally of low quality. This variety is sensitive to sunburn, rubbing and slight abrasions. All of these factors cause brown areas on the skin; these areas are usually the seats of infection. The relatively large amounts of side rots in this variety, after only a short shelf-life, are evidence of this phenomenon.

There were clear differences in percent of rot between the three shelf-life periods compared. After 2 days of shelf-life there was a notably higher percent of side rots than of stem-end rots. Following 7 days of shelf-life the percentage of stem-end

rots rose; these rots were often accompanied by external mycelia. In addition, following long shelf-life periods, there was a rise in the percent of berries which had completely rotted. In this variety the largest amount of rotting was caused by Alternaria and by Aspergillus niger.

Most of the stem-end rot was caused by Alternaria, and this rot increased with the lengthening of the shelf-life. SO<sub>2</sub> treatments greatly reduced the amount of rot, but, even so, the percent of rot remained quite high (above 10%).

#### Sultanina

As mentioned previously, it was mainly the length of the shelf life that influenced the percent of rotting, but in Sultanina the temperature also had an effect. In fruit that had a short or intermediate shelf-life (2-4 days), the percent of rot at 25° was greater than that at 17°C. This difference disappeared after a longer shelf-life of 7 days (see Figure 1B).

Alternaria and Cladosporium were the main rot-causing organisms in this variety as well, while Stemphylium was found only to a small extent. In this variety, which suffers mostly from dry drop, Cladosporium rot appeared mostly on the side. Alternaria and Stemphylium appeared on stem-end and on side rots in equal amounts.

Aspergillus niger was rare in this variety and appeared mostly on the side. At times, Penicillium species were also isolated.

Yeasts also appeared mostly on the side, and were not reduced by the SO<sub>2</sub> treatments.

#### Alphonse Lavallée

Rotting in general was very low in this variety. Due to its good keeping qualities it was examined for rotting after 9 days, instead of after 7 days, of the prolonged shelf-life allowed for the other varieties under consideration in these experiments. Despite the fact that packing was done under commercial conditions and without special supervision, only a small amount of decay developed. The fruit remained firm for the first 7 days of shelf-life and softening started only after a shelf-life

of 9 days. With the lengthening of the shelf-life there was a rise in the stem-end rots, but the percent of side rots did not rise considerably.

Alternaria was the main rot-causing organism. Few Stemphylium, Cladosporium or Penicillium rots appeared, and then only in the non-SO<sub>2</sub> treated fruit. No Botrytis was found. On the other hand, yeasts were isolated from many rots even after only 2 days of shelf-life; a greater amount of yeasts was isolated after 4 days' shelf-life. Aspergillus niger appeared in fruit which had a long shelf-life, i.e. 9 days. Aspergillus was often accompanied by yeasts. SO<sub>2</sub> treatments did not greatly reduce Aspergillus rot and yeast rot, which agrees with results obtained with Queen of the Vineyards.

#### DISCUSSION

The kind of drop (wet or dry) was found to correspond with the frequency of stem-end rots. Queen suffers from wet drop and few shattered berries escaped decay. Alphonse, which suffers from wet drop, also suffered a great deal from stem-end decay. In Sultanina, on the other hand, which is a variety with dry drop, many shattered berries did not decay.

Most of the stem-end rots were caused by Alternaria. K<sub>2</sub>S<sub>2</sub>O<sub>5</sub> powder which emanated SO<sub>2</sub> was found to be efficient in preventing the development of this fungus, and thus considerably reduced stem-end decay. As opposed to this, there was no reduction in rots which were due to Aspergillus or yeasts. Aspergillus and yeasts usually appeared at the late stages of shelf-life, and it is possible that the amount of SO<sub>2</sub> that was emanated after such an extended shelf-life could no longer be effective for decay control. It would therefore be desirable to lengthen the period of SO<sub>2</sub> emanation, and in sufficient quantities for controlling rotting; this can be done by improved methods of application. In vitro investigations are also needed to study the effects of SO<sub>2</sub> application on the various fungi. In addition, in vivo and in vitro investigations must be undertaken to find new effective fungicides, especially against those fungi which SO<sub>2</sub> was found to be ineffective in controlling.

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S U M M A R Y

Investigations have been made on export grape varieties on the effect of shelf-life (following cold storage) on marketability.

Shelf-life consisted of 2, 4, 7 or 9-day periods at two different temperatures: 17°C and 25°C. The effect of these shelf-life conditions was compared on  $K_2S_2O_5$  treated fruit as well as on untreated fruit.

"Queen of the Vineyards" was found to be the variety most severely attacked by decay. "Alphonse Lavallée" was found to be the most resistant. Waltham Cross and Sultanina were intermediate concerning rot development.

Alternaria tenuis was responsible for most of the stem-end rots. The following organisms were also isolated: Aspergillus niger, yeast species, Stemphylium species, Cladosporium herbarum, Botrytis cinerea and Penicillium species.

The  $K_2S_2O_5$  powder reduced mainly rots caused by Alternaria and Cladosporium. There was no clear reduction in rots which were caused by Aspergillus niger or by yeasts.

R E F E R E N C E S

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