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ALTERNATE METHOD OF ONION STORAGE WITHOUT THE APPLICATION OF A GROWTH REGULATOR

KEY WORDS: Allium cepa, maleic hydrazide, storage, sprouting

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ABSTRACT

The effect of relative humidity on keeping quality of onions (Allium cepa cv. Downing Yellow Globe) was investigated as an alternative to the application of growth inhibitor, maleic hydrazide. Eleven months after storage at 40% or lower relative humidity and 3±1 °C temperature about 70 to 81% of the onions remained in good marketing quality and 80 to 97% in good eating quality. Data presented show that a considerable potential exists for successful storage of onions without the use of maleic hydrazide.

INTRODUCTION

Onions stored for a long period of time tend to sprout, making them unfit for marketing. Since the demonstration of its effectiveness by Wittwer et al. (1950), the growth inhibitor maleic hydrazide (MH) has been widely used by commercial growers to prevent sprouting of onions in storage. A considerable amount of work has been done to determine effectiveness of MH and its mode of action (c.f. Pedeliski, 1973). Used as a spray, MH-30 is routinely recommended by horticulture departments (e.g. Turnquist et al. 1975, Burr, 1975).

Long before the use of MH became popular, the effect of environmental factors on onion storage had been investigated. As early as 1933, Rose, Wright and Whiteman found that a temperature of 0 ^{o}C with 70-75% relative humidity (RH) was desirable for successful storage of onions for a period of 5-6 months. Later, Wright, Lauritzen and Whiteman (1935) reported 0 ^{o}C temperature and about 65% RH as providing the best conditions for storage. William (1937) in Australia obtained the best results at 0 ^{o}C temperature and a humidity of 87%. Karmarkar and Joshi (1942) found that onions stored at 0 ^{o}C remained dormant for 6 months. Similar results were obtained by Yamaguchi et al. (1957) and Pratt and Morris (1958). Although the best temperature for storage was found to be 0 ^{o}C, commercial cold storage is usually at 2 to 5 ^{o}C. This is because of the technical difficulties in the functioning of cooling units at 0 ^{o}C.

In most of these studies, the RH was left uncontrolled and major emphasis was given to the storage temperature. Even in later work by Abdalla and Mann (1963), RH was not controlled. They reported the relative humidities as between 80-98% for most of the temperatures studied. This high RH is characteristic of most commercial storage and explains the poor results inspite of the low temperature. In order to overcome this difficulty, treatment with MH was adopted, since it prevented sprouting even at 2 to 5 ^{o}C. Because of the success of this procedure further research in the area of environmental conditions for prolonged storage of onions has been neglected.

The purpose of this study was to investigate if reducing RH below 65% (the lowest humidity tested in the earlier work) would be satisfactory for storing onions above freezing (3±1 ^{o}C) without the use of MH.

MATERIALS AND METHODS

The onions used in the present study were grown at the University of Minnesota Sand Plain Experimental Field in the summer 1974. No pesticides or herbicides were applied. The onions were harvested in early October, cured in a drying room (RH less than 20%) at 20^{o} C for 3 weeks and then transferred to a cold room maintained at 5±1 ^{o}C and about 75% relative humidity. After about 2 months, medium size onions weighing about 170 g each were selected and transferred to large plastic containers (45 cm diameter and 60 cm high) maintained at 5, 40, 90 and 100%

relative humidities. The method described by Osborne and Bacon (1961) using glycerol solutions was used to control the different humidities. The essential features of the humidity control unit are shown in Fig. 1. Sixty onions were used for each treatment. Onions showing root and shoot growth were counted after about 11 months of storage at the various humidities.

RESULTS

The data on the effect of relative humidity on onion quality after 11 months of storage is presented in Table 1. The

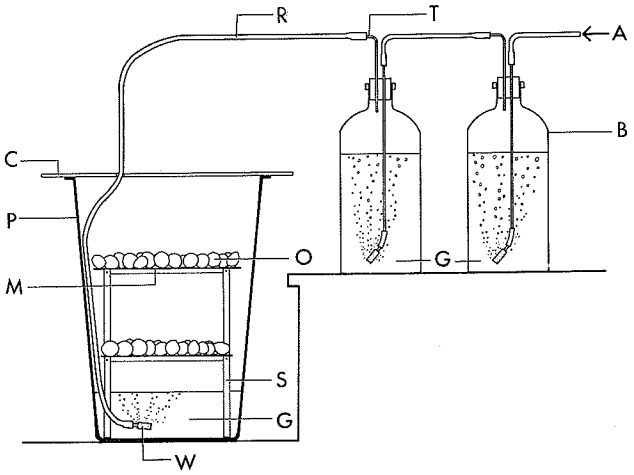

Fig. 1. The humidity control unit. Here A - Air Inlet at constant flow rate (about 800 cm^3/min), B - Glass bottle, C - Cover for plastic container with a hole for rubber tubing, G - Glycerol solution, M - Metal racks with screen on top to hold onions, O - Onions, P - Plastic container, R - Rubber tubing, S - Stand, T - Glass tubing and W - Aerating block.

Table 1. The effect of the relative humidity of the air on onion qualities after 11 months of storage at 3±1 °C.

Relative humidity %	Vapor pressure gradient at the experimental temperature (mm Hg)	Loss in weight %	Percentage of Onions						
			With visible roots	With visible shoots	Marketable[1]	Rotten[2]	Loss of Turgor[3]	Edible	Perfect[4]
5	5.03	27	0	19	81	3	11	97	44
40	3.18	25	10	20	70	20	10	80	33
90	0.53	8	96	23	4	57	--	43	4
100	0.00	7	100	21	0	83	--	18	0
75[5]	1.64	18	60	49	13	47	--	53	13

[1]Marketable Onions = total onions - (with visible roots + with visible shoots including rotted and those that lost turgor).

[2]All of the rotted onions had visible root growth or shoot growth or both.

[3]Loss of turgor means onion appeared soft, dry and has lost firmness but were still suitable for eating. All of these onions had visible shoot growth.

[4]Perfect Onions = total onions - (onions with any signs of growth inside as well as outside + rotted onions).

[5]Onions kept at 5±1 °C.

percentage of onions with visible shoots was not affected by humidity but was controlled by temperature (Table 1). With an increase in temperature from 3 °C to 5 °C, (row 5, Table 1) the percentage of onions with visible shoots increased by almost 2.5 times. In contrast, the percentage of onions with visible roots was directly related to humidity. These findings parallel earlier work (Rose et al., 1933, Wright et al., 1935). The observation which is of great interest here is that when stored for 11 months at a RH of 40% or less, 70-81% of the onions remained marketable and 80-97% edible These figures would undoubtedly have been even better if low humidity storage had started immediately after harvest. Although about 10% of the onions were flacid at 5 or 40% RH treatments, they were edible.

There was a 25% and 27% loss in weight of onions stored at 5% and 40% RH respectively. This weight loss was considerably higher than at 90% and 100% relative humidities. At 75% RH, the onions lost 18% of their weight. It must be pointed out here that these losses in weight were incurred after 11 months of storage. The usual storage period of onions is about 5 to 6 months. If one assumes that weight loss occurs at a constant rate, the onions would lose only 12% to 14% of their weight at low humidities (5% and 40%) during the normal storage period.

Considerable losses are experienced in the storage of onions as a result of rotting. The number of rotten onions was also counted in each treatment at the end of 11 months storage. Only 3% of the onions rotted at 5% RH. There was an increase of 6-7

times in percentage of rotted onions with increase in RH from 5% to 40%. At 90% RH the percentage of rotted onions increased to about 20 times the percentage found at 5% RH. This indicates that although there is a greater weight loss at low humidities, the loss of onions by rotting is smaller. Including rotted onions in total weight loss of stored onions, there was 30% total loss in weight of onions at 5% RH as compared to 45%, 65% and 89% total losses in weight at 40%, 90% and 100% relative humidities respectively.

CONCLUSIONS

It can be safely concluded from the data presented that considerable potential exists for the successful storage of onions without the application of the growth regulator, maleic hydrazide, by using low humidity at 3 ± 1 ^{o}C temperature. This will, however, require an economical way of lowering the humidity at this low temperature. It is hoped that the results presented here will serve the purpose of reviving interest in alternative methods of onion storage. More research needs to be done in this direction. Our data suggest that onions will keep as well or even better when stored at relative humidities below 40%, without the need for application of MH.

FOOTNOTE:

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