Proc. Fla. State Hort. Soc. 97:106-108. 1984.

SOME EFFECTS OF CULTIVAR, BULB SIZE AND PREHARVEST TREATMENTS ON STORAGE CHARACTERISTICS OF NORTH FLORIDA ONIONS[1]

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Additional index words. decay, weight loss, sprouting, maleic hydrazide, paraquat.

Abstract. **The effects of cultivar, bulb size and preharvest treatments on the storage of Florida-grown onions (*Allium cepa* L.) were studied in 2 separate experiments. Cultivar and bulb size effects were studied with three Gainesville-grown cultivars: 'F1 Yellow Granex PRR', 'Texas Early Grano 502 PRR' and, 'Texas Grano 1030Y'. The preharvest treatment study was done in Hastings with one cultivar, 'Granex 429'. Treatments consisted of a complete factorial arrangement of with and without maleic hydrazide; with and without paraquat; and with and without rolling of the tops. Following harvesting and curing the sound bulbs were stored at 1°C for 3 or 4 months. Samples were taken every 15 days to determine dry weight, bulb rot, root sprouting and firmness. All the parameters measured were significantly affected by cultivar and length of storage. 'F1 Yellow Granex PRR' had the highest dry weight (10.2%) and firmness (30.1 Newtons). Firmness was significantly affected by bulb size with the small bulbs being firmer. 'Texas Grano 1030Y' exhibited the lowest values for weight loss (0.8%), bulb rot (0%), and root sprouting (18.9%) over the entire storage period. Both maleic hydrazide and rolling of the tops reduced the incidence of bulb decay during storage whereas paraquat had no significant effect. Maleic hydrazide reduced root sprouting by 42% but paraquat increased this by 33%. Rolling of the tops reduced the effect of maleic hydrazide on controlling root sprouting.**

Postharvest losses are common in stored onions due to diseases, weight loss and/or sprouting. Well-cured bulbs and low temperatures are required for satisfactory storage. In spite of attempts that have been made to improve the curing process with artificial means (4, 5, 6, 8, 17), curing the bulbs under field conditions continues to be the most economical method in Florida. Field curing, however, is difficult to attain under the Florida weather conditions prevalent at harvest when high relative humidity and frequent rainfalls are likely. These represent ideal environmental conditions for rotting. Furthermore, drying of the foliage is delayed and new growth of leaves is sometimes observed.

Preharvest foliar desiccation could reduce disease in storage by reducing field curing time and exposure to rains (3). In practice, however, chemical treatments have often resulted in increased storage losses due to disease as well as root and shoot sprouting (3, 15, 16). In other cases, results were inconclusive (20). Rolling of the tops as an alternative for facilitating drying of the foliage has also given no conclusive results (16). On the other hand, the use of maleic hydrazide has greatly facilitated the maintenance of onion bulb quality in storage with respect to inhibition of sprouting, root development, and the reduction of weight loss (2, 9, 11, 12, 14, 18). However, proper applications including rates and time of spraying should be checked at each location in order to avoid problems such as loose scales, sprouting and storage rot (18). Smaller bulbs and cultivars with high dry matter are reported to store better than larger bulbs and lower dry matter cultivars (2, 3, 7, 19, 21). These factors have not been adequately studied in the case of Florida onions.

The objective of the present study was to observe and evaluate the effect of some preharvest treatments as well as the role of cultivars and bulb size in the storage characteristics of Florida-grown onions.

Materials and Methods

Experiment 1. Effect of cultivar and bulb size. Bulbs of 3 yellow cultivars 'F_1 Yellow Granex PRR' (YG); 'Texas Early Grano 502 PRR' (TEG 502) and; 'Texas Grano 1030Y' (TG 1030Y) were harvested on June 2, 1983 from a cultivar trial conducted at the Horticultural Unit in Gainesville. After curing for 1 week in a greenhouse with ventilation the bulbs were sized into two categories: large (7-9 cm) and small (4-6 cm).

Experiment 2. Effect of preharvest treatments. Onions of the yellow cultivar 'Granex 429' (G 429) were grown at the Hastings Agricultural Research and Education Center. Preharvest treatments were maleic hydrazide (MH), paraquat (PQ) and rolling of the tops (RT). Treatments were applied at maturity, but no more than 10% of the tops had fallen over. MH at 2.27 kg a.i./ha was applied 16 days before harvest followed by RT four days later. PQ at 1.18 liters a.i./ha was sprayed 2 days after the tops were rolled. The experiment was a complete factorial of with and without MH; with and without PQ; and with and without RT; arranged in a randomized complete block design with three replications. Each plot consisted of a 12-m length of the 1-m wide bed with 2 rows of onions to the bed.

The bulbs were harvested on May 20, 1983 and immediately taken for curing to the seed drying facilities of the Agronomy Department at the University of Florida at Gainesville where they remained for 2 days at 32°C. Air was kept circulating in the driers.

Sampling for storage. After curing, the sound bulbs were topped and the roots pruned, placed in 4.5 kg onion bags (6 bulbs per bag constituted a sample), weighed and placed in storage at 1°C for 4 (expt. 1) or 3 (expt. 2) months. Relative humidity of the storage room ranged from 80 to 90%.

Data collected. Samples were taken every 15 days for determination of weight loss, dry weight, disease incidence, sprouting, and firmness. Weight loss was calculated as % weight loss from the initial weight. A longitudinal 1 cm-thick slice was taken across the bulbs and the dry weight of the 3 outermost and 3 or 4 innermost scales determined separately by drying the samples to a constant weight (65°C for 72 hr). The number of scales per bulb ranged from 8 to 10. Any bulb affected by disease or with any signs of sprouting was classified as rotted or sprouted, respectively. *Pseudomonas* sp. and *Botrytis* sp. were determined to be the main causes of rotting during the storage trial. Firmness was assessed using an Instron 1130 with a 50-kg load cell. Two measurements were taken per bulb by depressing 2 mm along the equatorial axis with a 12 mm-wide probe. The results were expressed in Newtons (N).

[1]Florida Agricultural Experiment Stations Journal Series No. 6036. The authors wish to gratefully acknowledge D. J. Cantliffe and J. R. Shoemaker for providing the onions used in these experiments.

Results and Discussion

Bulb size had no statistically significant effect on weight loss, decay, root sprouting or dry matter content (data not shown). Small bulbs were significantly firmer than large bulbs initially and throughout storage (30 N and 27.1 N after 4 months storage, respectively). Karmarker and Joshi (13) reported that smaller bulbs had greater weight loss than larger bulbs, but other researchers have not found a consistent relationship between bulb size and weight loss (19). The lack of differences in the dry matter content of large and small bulbs is consistent with the findings of Ward (21) and Woodman and Barnell (22). Generally, our results for bulb size did not reveal any effect on storage characteristics of commercial significance.

The cultivar TG 1030Y had less weight loss, decay and root sprouting compared to the other cultivars (Table 1). The rate of root sprouting for TG 1030Y was also less than that of the other two cultivars (Fig. 1). Based on these factors, cultivar TG 1030Y was clearly a better storage onion than the other two cultivars. Anderson (1) recently reported that TG 1030Y had the least weight loss (<10%) in an ambient air storage trial in Texas. The low temperature and high humidity in our storage trial reduced weight loss to an extremely low level when compared to Anderson's results (1), but the TG 1030Y cultivar still had the best performance characteristics.

Preharvest treatments (MH, PQ, RT) had no significant effect on weight loss, dry matter content, or firmness changes during storage (data not shown). The fact that firmness was not affected by preharvest treatments is especially important in the case of MH which when applied to immature bulbs may cause a reduction in bulb firmness (18). Our results for weight loss contradict those of Richardson et al. (15), where PQ treatment increased the % weight loss of bulbs during storage. The high humidity of our storage room may have contributed to the difference in our results.

Table 1. Effect of cultivar on the storage characteristics of onions stored for 4 months at 1°C.

Cultivar	Root sprouting (%)	Rotted bulbs (%)	Weight loss (%)	Dry weight (%)	Firmness (N)
'Fl Yellow Granex PRR'	48a[z]	2a	1.5b	10.2a	30a
'Texas Grano 1030Y'	19b	0a	0.8a	9.7b	29a
'Texas Early Grano 502 PRR'	44a	12b	1.5b	9.3b	27b

[z]Mean separation in columns by Duncan's multiple range test, 5% level.

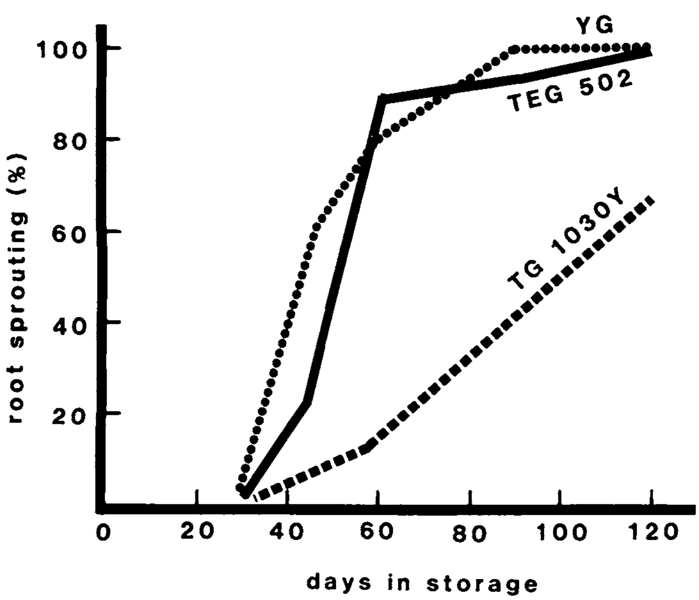

Fig. 1. Root sprouting of the cultivars 'Fl Yellow Granex PRR' (YG), 'Texas Early Grano 502 PRR' (TEG 502) and 'Texas Grano 1030Y' (TG 030Y) during storage.

Both MH and RT decreased the incidence of decay during storage (Table 2). The significantly lower levels of rotting found in the MH and RT treatments could have been due to a general promotion of bulb dormancy and/or senescence of the tops during harvest time allowing a better and faster drying of the foliage, which in turn reduced the amount of inoculum in the bulbs. According to Bubl et al. (3) the migration of pathogens into the bulbs might be stopped by rapidly reducing foliage and neck moisture. The effectiveness of MH in reducing rotting and in prolonging the storage life of the bulbs has been reported (2, 9, 12, 14). Although in a recent study Stallknecht et al. (18) found no differences between MH treated and control bulbs, the overall low incidence of bulb rotting during their experiment may have contributed to the lack of significance of the MH treatments. Bending over the tops has been proposed to promote foliage senescence (16). This was evident in our plots where RT was applied as noticed by a faster drying of the tops.

Table 2. Effect of preharvest maleic hydrazide application or rolling bulb tops on decay of bulbs during 3 months storage at 1°C.

Treatment		Decay (%)
Maleic hydrazide	without	36[z]
	with	30
Rolling tops	without	52[z]
	with	28

[z]Means significantly different by the F test, 5% level.

Our results do not confirm those of earlier studies where PQ and other desiccants caused an increase in onion disease during storage (3, 15, 16). It was proposed that the desiccants might prevent the translocation of antifungal agents to the bulb, rendering the bulbs more susceptible to pathogens. However, some chemicals, rates and timings were less detrimental than others (3, 10, 19). This may have been the case in our experiment. It could also be that the general level of disease incidence masked the actual effect of PQ on the rotting of bulbs. In our experiment rotting was over 30% for the non-treated bulbs whereas in the other experiments (3, 15, 16) the controls had less than 10% rotting.

Overall means for root sprouting after storage were high for both Hastings (64%) and Gainesville (89%) although final root growth (<1 cm) was very much arrested by the low temperature. The high relative humidity in the storage room may have contributed to the high observed values (17). Preharvest treatment with PQ increased root sprouting during storage (57% and 43% sprouted for with and without PQ, respectively). Other experiments showed no enhancing effect of PQ on root sprouting during storage (15). However, similar results to those obtained in our experiment regarding the effect of PQ on root sprouting were found by Bulb, et al. (3). According to these authors the observed increase in the incidence of root sprouting may be due to the interruption of the biosynthesis and/or transport of natural dormancy—promoting compounds found in the foliage, or interruption of the transport of the applied sprout inhibitor MH into the meristem of the bulb. The latter may be supported by our finding that RT and PQ significantly reduced the effectiveness of the sprout inhibitor MH (Table 3). The RT and PQ treatments were applied 4 and 6 days after MH, respectively. Apparently this did not allow enough time for MH transport.

Table 3. Interations of maleic hydrazide with rolling of the tops and paraquat on the incidence of root sprouting during 3 months storage.

Maleic hydrazide	Rolling of tops		Paraquat	
	without	with	without	with
without MH	66[z]	56	54[z]	68
with MH	25	46	27	44

[z]Means for interaction significantly different by the F test, 5% level.

Growing onions in Florida will remain risky because of the high probability of adverse weather conditions at harvest. The cultivar 'Texas Grano 1030Y' may offer some advantages because of its desirable storage characteristics. A preharvest treatment with MH may enhance the storability of Florida grown onions and provide for an extended marketing season. Rolling of the tops aided in field drying of the onions in our test. It is likely that a combination of MH and RT would be most beneficial to those wishing to store Florida onions. The timing of these treatment needs further investigation to allow for MH translocation prior to rolling the tops.

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Proc. Fla. State Hort. Soc. 97:108-111. 1984.

THE EFFECTS OF AN IMAZALIL-IMPREGNATED FILM WITH CHLORINE AND IMAZALIL TO CONTROL DECAY OF BELL PEPPERS

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Additional index words. pepper quality, condition, export, film wrapping, firmness, color.

Abstract. **Bell peppers (***Capsicum annuum* **L.) were treated with a chlorine and/or imazalil dip; one-half was individually wrapped in an imazalil-impregnated heat-shrinkable plastic film and one-half remained unwrapped. They were held in storage and evaluated for incidence of decay development after 1, 2, and 3 week at 7.2°C and after 5 additional days at 15.6°C. Bacterial soft rot (BSR) was the most prevalent decay identified but fungal decay caused by** *Alternaria* **sp. and** *Botrytis* **sp. developed to a lesser extent following 3-week storage. No treatment effectively controlled the development of BSR. The imazalil film alone and imazalil dip (500 ppm) alone significantly reduced the incidence of fungal rot but film wrapping increased the incidence of BSR compared to nonwrapping after 3 week at 7.2° + 5 days at 15.6°C. The effect of the imazalil film and imazalil dip in**