

Controlled-atmosphere Storage Suppresses Leaf Growth and Flowering in Onion Bulbs

Kil Sun Yoo and Leonard M. Pike

Vegetable Improvement Center, Department of Horticultural Sciences, Texas A&M University, College Station, TX 77843

Additional index words. *Allium cepa*, vernalization, seed production, breeding

Selected bulbs must be retained for seed production in onion (*Allium cepa* L.) breeding programs. In our short-day onion breeding program, bulbs are harvested between March and April in South Texas and planted in Central or West Texas for seed production in September. Many bulbs can be lost due to decay and sprouting in ambient storage (>25 °C) during the four to five months of summer. Refrigerated storage reduces bulb decay and sprouting, but may induce flowering soon after planting, which is not desirable in our breeding program. Therefore, bulbs have to be stored without flower induction, and with minimum losses, to ensure leaf growth in the fall, vernalization during the winter, and seed production the following spring.

Controlled atmospheres (CA) allow onion bulbs to be stored for ≈6 months with little storage loss (Smittle, 1988). However, to our knowledge, the effect of CA storage on flower induction has not been reported. This study was conducted to examine onion bulb sprout and flower induction during CA and ambient storage, and the suitability of such a system for keeping selected bulbs.

‘Texas Grano 1015Y’ onion bulbs were harvested on 30 Apr. and selected for medium size (≈250 g). The bulbs were held at 24 °C and then placed in storage on 28 May. Storage was at 4 or 11 °C, each combined with ambient air or 1% O₂. Two hundred onion bulbs were kept in four 22.7-kg corrugated boxes in open air or in a 190-L plastic drum flushed with 28.3

L·min⁻¹ of 1% O₂ air produced by an Airco (Houston) nitrogen generator. Relative humidity (RH) in ambient air at 4 and 11 °C was ≈90% [81 and 122 Pa vapor-pressure deficit (VPD)], while RH with 1% O₂ was ≈10% (731 and 1102 Pa VPD), respectively.

Thirty onion bulbs were removed from each treatment after 3, 4, 5, 6, and 7 months of storage. Leaf length was measured from 10 bulbs as replications. The remaining 20 bulbs were planted in 7.5-L pots (two bulbs/pot) and grown in a growth chamber at 25 °C day/18 °C night cycles, 12-h daylength, and 300 μmol·m⁻²·s⁻¹ photosynthetically active radiation provided by fluorescent and tungsten light. Leaf length data were analyzed as a completely randomized design. The percentage of 20 plants that flowered was determined after 2 months in the growth chamber.

Storage with 1% O₂ at 4 or 11 °C inhibited leaf growth equally effectively (Table 1). Leaf growth was fastest at 11 °C air and all bulbs had sprouted within 3 months. Leaf growth in air in bulbs at 4 °C was slower than at 11 °C, but all bulbs sprouted after 4 months. Low O₂ appeared to be a main factor for slowing down the shoot growth in 1% O₂, as demonstrated in other CA storage studies of onions (Smittle, 1988); however, we do not know the effect, if

any, of the ≈10-fold difference in VPD noted above.

Flowering was absent in bulbs stored up to 4 months regardless of treatment. Ambient air storage at 4 and 11 °C for 5 months induced 80% and 50% flowering, respectively. Ninety percent of bulbs had flowered after 7 months of storage at 4 °C with air. However, there was no flowering for bulbs that had been stored in 1% O₂ at 4 and 11 °C for 7 months, except for one plant (5%) at 4 °C. The low-O₂ air storage suppressed the flowering as it reduced the leaf growth.

Our results are in general agreement with previous reports indicating that 5 to 12 °C is most effective for flowering (Jones and Emsweller, 1937) and that 50% flowering requires 12 weeks at 8 °C in unsprouted bulbs (Bertaud, 1988).

Although air at 4 °C was most effective for flowering, only 90% of bulbs flowered even after 7 months of storage. The 11 °C ambient storage is unsuitable for keeping bulbs due to excessive sprouting.

This study demonstrated that onion bulbs can be stored for 4 months at 4 °C air or with 1% O₂, or at 11 °C with 1% O₂ without excessive sprouting and flowering for planting in September to early October. Onion bulbs can be kept up to 7 months in preparation for crossing or general seed production when stored at 4 or 11 °C with 1% O₂ air.

Literature Cited

- Bertaud, D.S. 1988. Effects of chilling duration, photoperiod and temperature on floral initiation and development in sprouted and unsprouted onion bulbs. Proc. 4th Eucarpia *Allium* Symp. p. 254–261.
- Jones, H.A. and S.L. Emsweller. 1937. Effect of storage, bulb size, spacing, and time of planting on production of onion seed. Calif. Agr. Expt. Sta. Bul. 628.
- Smittle, D.A. 1988. Evaluation of onion storage methods. J. Amer. Soc. Hort. Sci. 113:877–880.

Table 1. Leaf length of onion bulbs (‘TG 1015Y’) during 3 to 7 months of storage at 4 or 11 °C with ambient air or 1% O₂.

Storage condition	Leaf length (cm) ²				
	Length of storage (months)				
	3	4	5	6	7
4 °C, air	4.5 b ¹	5.0 b	9.2 b	11.3 b	12.2 b
1% O ₂	1.3 c	2.5 b	3.3 c	3.4 c	5.5 d
11 °C, air	10.6 a	28.0 a	35.6 a	60.8 a	70.0 a
1% O ₂	2.5 bc	3.8 b	5.1 bc	6.0 bc	8.8 c

¹Leaf length includes the internal growth.

²Mean separation within each column by Duncan’s multiple range test ($P \leq 0.05$).

Received for publication 24 July 1995. Accepted for publication 31 Mar. 1996. The cost of publishing this paper was defrayed in part by the payment of page charges. Under postal regulations, this paper therefore must be hereby marked *advertisement* solely to indicate this fact.