Research Report: Overwintering Onions in Low Tunnels, 2012 and 2013

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Background & Objectives: A handful of growers in the region have been experimenting with planting onion seedlings in the fall, covering them with low tunnels during the winter, and harvesting in the early spring. Some have reported good success, with an early harvest of beautiful bulbed onions, and others have reported challenges including poor survival and early bolting. In 2011-12, we planted seven varieties of onions in Durham at the NH Agricultural Experiment Station (zone 5B), to evaluate potential for overwintering and early spring harvest. In 2012-13, we broadened our study and included ten varieties in Durham and included two varieties in North Haverhill NH (zone 4B). In this second year, we also evaluated overwintering onions without the benefit of protective low tunnels.

This study was done in collaboration with University of Massachusetts researchers, as part of NESARE project LNE10-297.

Cultural Methods: Onions were grown in a randomized complete block design with 4 replicates, 24 plants per rep. Seeds were provided by or purchased from Johnny's Selected Seeds (JSS), Seedway Seeds (SW) and Territorial Seeds (T). Onions were seeded in 98-cell transplant trays and were transplanted outdoors at a spacing of 6" apart in three rows 6" apart on raised beds covered with embossed black plastic mulch. Low tunnels made of 10' PVC bows were installed over the onions in late fall. Plants were covered with heavy duty rowcover (1.25 oz/yd^2) and an additional layer of greenhouse poly (6mil) for the winter. Dates of cover application and removal are shown below. In 2012-13, half of the onions were grown under low tunnels, and half were not covered. In both years, we used two planting dates (A and B).

Table 1. Important Dates for Onion Trial

	2011-12		2012-13			
	Durham		Durham		North Haverhill	
Activity	**A**	**B**	**A**	**B**	**A**	**B**
Seeded:	Aug 18	Aug 18	Aug 25	Sep 15	Aug 25	Sep 15
Transplanted:	Sep 20	Sep 30	Sep 20	Oct 20	Oct 11	Oct 21
Added rowcover:	Oct 18	Oct 18	Oct 20	Oct 20	Nov 6	Nov 6
Added plastic:	Dec 16	Dec 16			Nov 6	Nov 6
Removed plastic:	Mar 14	Mar 14	Apr 15	Apr 15	Apr 7	Apr 7
Removed rowcover:	Apr 5	Apr 5			Apr 9	Apr 9
Assessed survival:	Mar 13	Mar 13	Apr 30	Apr 30	Apr 24	Apr 24
1st Harvest:	May 12	May 12	May 22	May 22	Jun 13	Jun 13
2nd Harvest:	May 24	May 24	Jun 3	Jun 3	Jun 22	Jun 22
3rd Harvest:	Jun 6	Jun 6	Jun 20	Jun 20	Jul 2	Jul 2
4th Harvest:	-	-	-	-	Jul 15	Jul 15

Data Collected:

In early spring, plant vigor (number of intact leaves) and percentage of overwinter survival were measured. As soon as onions were sufficiently bulbed to be considered harvestable, subsamples of 6 plants were harvested from each plot. Subsequent harvests were made at 2-week intervals. Bolting and bulb size were measured at each harvest.

Results:

1. ***Low Tunnel Environment.*** The low tunnel covered with 1.25 oz/yd^2 rowcover and 6 mil plastic provided substantial temperature protection compared with outdoor temperatures.

   Table 2. Winter Low Temperature Protection by Low Tunnel in Durham NH.

	Minimum Air Temp		Minimum Soil Temp	
	Outdoors	Low Tunnel	Outdoors	Low Tunnel
2011-12	-9.6 °F	13.8 °F	20.7 °F	34.8 °F
2012-13	-3.5 °F	7.5 °F	20.0 °F	32.0 °F

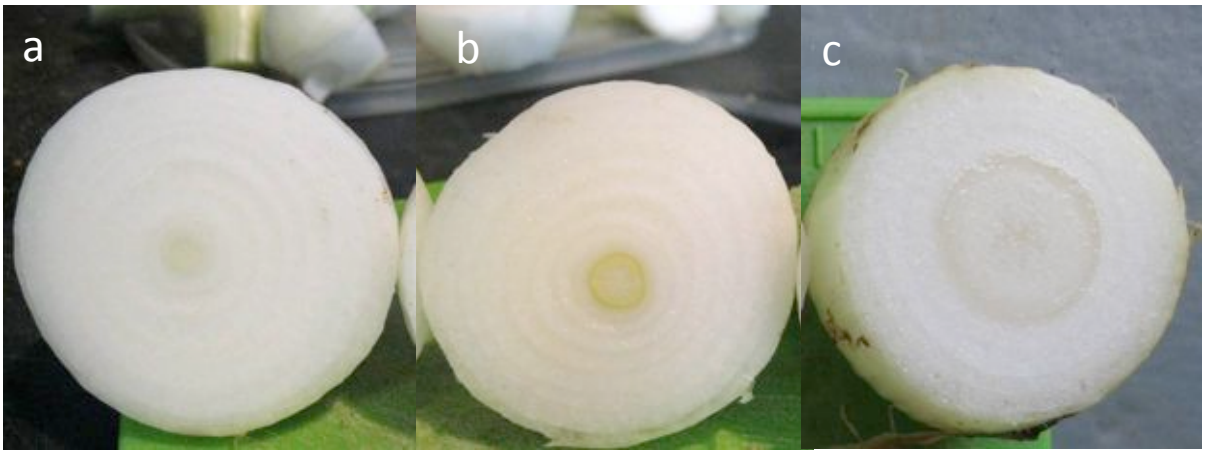
   While air and soil temperatures fluctuate widely inside as well as outside the low tunnel, the minimum temperatures reached in the low tunnel are much warmer than outdoor temperatures. Notably, the soil temperature inside the soil tunnel never went below freezing. **The low tunnel is a protected environment, and any conclusions about our results should take this into account.**

   In 2012-13, we grew overwintering onions outside the low tunnel (uncovered) as well as inside the low tunnel. While onions survived unprotected in both sites, the survival and spring vigor were much lower without the protection of the low tunnel. For example, in Durham, survival ranged from 30-44 % outside the low tunnel, and 62-88% inside the low tunnel. Unexpectedly, survival of unprotected plants was better in the colder site, N. Haverhill (80-85% outside vs. 93-98% inside the low tunnel). This may have been because the colder site was more protected (surrounded by trees, in a slight depression) or because of extended snowcover.

2. ***Onion Survival.*** In low tunnels, all varieties survived the winter equally well. In 2011-12, survival was over 97% for all varieties. Survival was a bit lower in 2012-13, ranging from 62-88% for all varieties in Durham, and 96-98% in N. Haverhill.

3. ***Onion Plant Vigor.*** In spring of the 2011-12 season, varieties differed in terms of plant vigor. The varieties Keepsake, T-420 and TopKeeper were significantly taller and/or had more intact leaves than the two least vigorous varieties, Walla Walla and Winter White Scallion. Bridger and Hi-Keeper were intermediate. We assessed vigor for only a subset of varieties in 2012-13. We found that vigor was greater for the earlier fall planting than for the later planting, and for onions that had been under low tunnels than for those that had been outside.

4. ***Bolting.*** Bolting is triggered by a vernalization period (exposure to prolonged cold temperatures) once the plant has reached 4-6 true leaves. By late April in both years, flower stalks (scapes) were evident on some plants of several varieties. On bolted plants, scapes were evident in the center of the bulb as a small pithy core. For later harvest dates, bolting rendered bulbs unmarketable because it reduced bulb size and because the majority of the bulb was the large pithy scape.

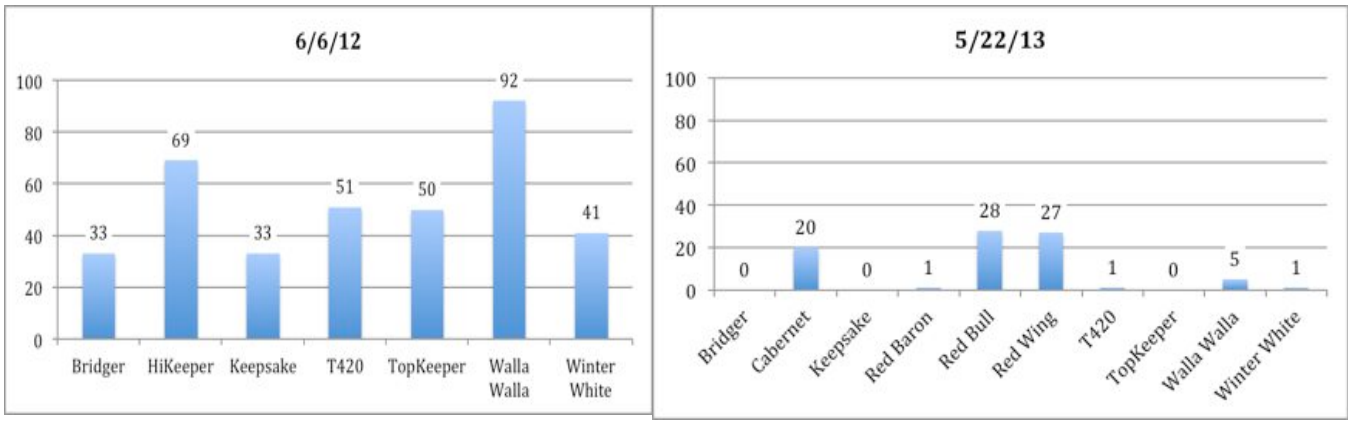


Onion cross-sections at various stages of bolting: a) non-bolted - no scape visible, b) early bolting – small scape visible, and c) late bolting – enlarged scape in center of bulb.

The percentage of bolting was higher in the first year (2011-12) than in the second year (2012-13), across all varieties. In both years, the earlier fall planting showed a higher percentage of bolting than the later planting.

By harvest time, varieties showed significant differences in percentage of bolting. In 2011-12, Walla Walla had nearly 100% bolted plants, significantly more than all other varieties except Hi Keeper, which averaged 69% bolting. In 2012-13, Walla Walla showed much less bolting (5%), but the red cultivars Red Bill, Red Wing, and Cabernet all had over 20% bolting. Virtually no bolting was observed in the N. Haverhill experiment in 2012-13.

Percent Bolted Plants of Overwintered Onion Cultivars, Durham NH



5. ***Varieties.*** *Winter White Scallion (*T*)* is a hardy non-bulbing scallion, which was grown because of its hardiness, but was not expected to bulb. It did not produce bulbs, but instead produced long white leek-like shanks that had a slight enlargement on the bottom. It could be creatively marketed as an oversized scallion in the spring, but not as a typical bulbing onion.

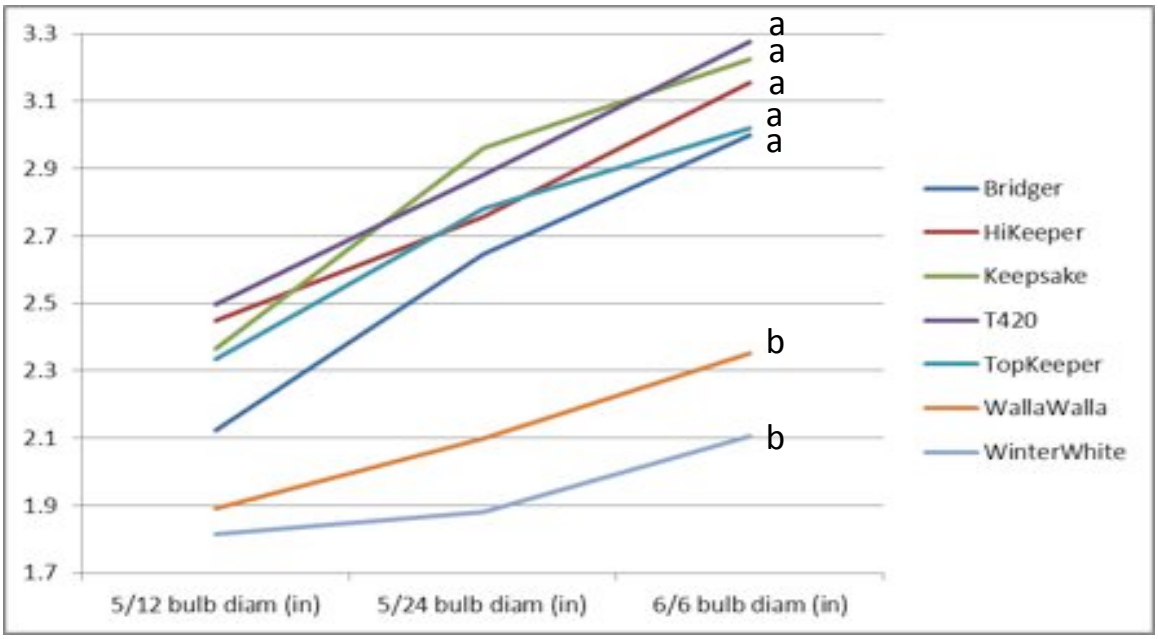
   *Walla Walla (*SW*)* is a long-day sweet onion commonly fall-planted in the Pacific Northwest as an overwintering onion. In the first year of our trial, it bolted quickly and did not produce large bulbs, perhaps because it bolted before our days reached the 14-16 hour daylength required to initiate bulbing. In the second year of our trial, Walla Walla produced very nice bulbs and did not show a high percentage of bolting.

   *Top-Keeper (*T*), Hi-Keeper (*T*), T-420 (*JSS*), Keepsake (*T*)* and *Bridger (*JSS*)* are yellow storage varieties that produced high quality bulbs in our production system. These varieties varied in their tendency to bolt and in overall bulb size, but all produced marketable early onions.

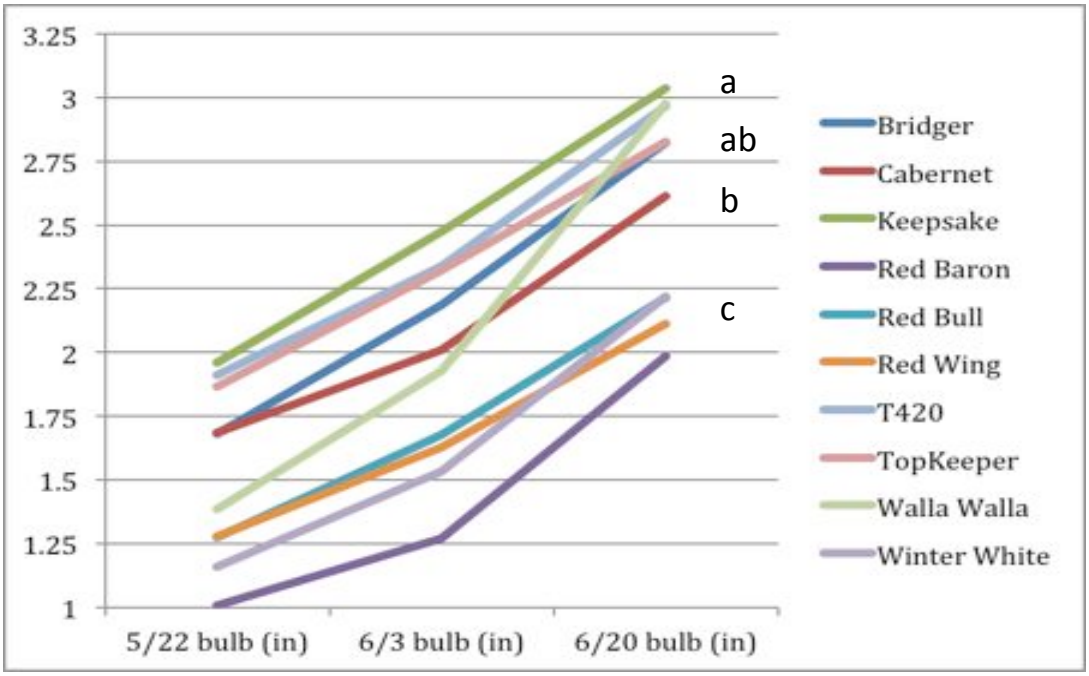
   Red onions were included only in the second year of the evaluation, 2012-13. *Red Wing (*JSS*)* and *Red Bull (*JSS*)* are red storage onions, *Red Baron (*T*)* is a red scallion, and *Cabernet* (JSS) is an early summer red onion. Of these, Cabernet was the only one that produced marketable bulbs, but it exhibited a relatively high percentage of bolting (20%).

6. ***Bulb Size.*** In 2011-12, two varieties did not form large bulbs: Walla Walla and Winter White Scallion. For the other five varieties, bulbs began to form in April and continued to enlarge until our final harvest on Jun 6. Average bulb diameters ranged from 2-2.5" on May 12, from 2.6-3" on May 24, and from 3-3.25" on Jun 6. Weight of trimmed bulbs for these five varieties ranged from 4-5.5 oz on May 12, and from 5.5-7.5 oz on May 24.

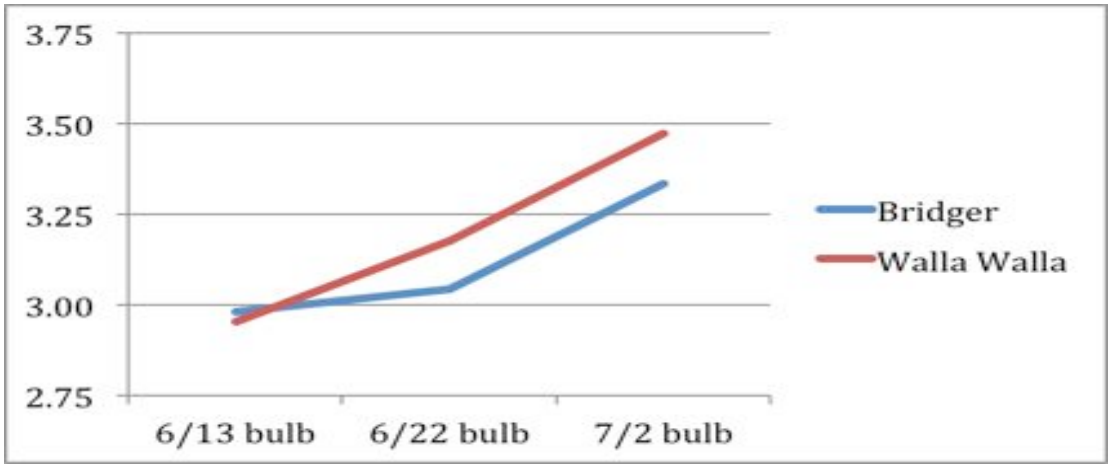
Bulb Diameter (inches) Over Time of Overwintered Onion Cultivars, 2011-12



In 2012-13, bulbs of all varieties enlarged over time, but four varieties did not form large bulbs (>2.25 in): Red Baron, Red Wing, Red Bull and Winter White. The remaining six varieties formed large bulbs by our final harvest on June 20, with weight of trimmed bulbs ranging from 6.6 to 10 oz at that time. Average bulb diameters of these larger varieties ranged from 1.7-2" on May 22, from 1.8-2.5" on June 3, and from 2.6-3.1" on June 20.



In 2012-13, two varieties were grown in North Haverhill (zone 4B). Both Bridger and Walla Walla bulbed nicely, and large (3" diameter) bulbs were ready for harvest by June 13.



7. ***Planting Date.*** Fall planting date had an effect on survival, spring vigor, time to maturity, and percentage of bolting in the spring. Seeding early (mid-August vs. mid Sept.) resulted in more fall growth – which translated into a higher chance of bolting in the spring. However, the earlier planting was more vigorous in the spring and produced marketable bulbs (if plants didn't bolt) sooner. To some extent, there is no 'ideal' planting date because performance will depend on the fall weather (long and warm vs. short and cold), which is inherently unpredictable. As a result, we recommend that you experiment with planting dates in your own conditions to fine-tune dates, and use our results only as a guideline.

Conclusions: We experienced good success with overwintering onions. Low tunnels provided a protected environment that allowed onions to grow well over winter in Durham, NH (USDA hardiness zone 5B) and in N. Haverhill NH (zone 4B). With both mid-August and mid-September seeding dates, onions were ready for harvest in late May-early June. Bulbs continued to increase in size until late June. The varieties TopKeeper, Hi-Keeper, Keepsake, Bridger and T420 produced nice bulbs in both years; Walla Walla did well in one out of the two years. Of the red varieties evaluated, Cabernet performed best, but it did show a significant percentage of bolting. Planting later in the fall appears to reduce the chances of spring bolting, but there is a tradeoff - the bulbs are also smaller and slightly later to mature. With any questions, please contact Becky Sideman at becky.sideman@unh.edu or call 603-862-3203.

Onions in low tunnels throughout the seasons.

Onion varieties grown over winter in low tunnels. Photos taken on June 20, 2013. Photos were taken of the later fall planting (seeded Sept 15, transplanted Oct 20), which showed less bolting than the earlier fall planting for those varieties that bolted (Red Wing, Red Bull, and Cabernet).


bridger


cabernet


keepsake


red baron


T420


red wing


top keeper


red bull


walla walla


winter white