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The Effect of Temperature and Light During Bulb Storage on Traits Related to Onion Seed Production[1]

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Abstract. **Light had no significant effect on traits related to onion (*Allium cepa* L.) seed production by plants from bulbs which had been exposed to various light and temperature treatments during storage. However, storage temperature affected seed yield/plant, number of seed/plant, number of seed/umbel, weight of individual seeds, and number of leaves/plant. Plants from bulbs stored at 7°C the first half and 2°C the last half of the storage period had the highest seed yield and the greatest number of seeds/plant. The heaviest seeds were produced by plants from bulbs that were stored at both 2° and 7° during the storage period. Bulbs stored at 2° and then at 7° produced plants that had fewer leaves than plants from bulbs stored at the 2 other temperature regimes.**

Studies of effects of bulb storage temperature on subsequent growth and reproductive development of onion have shown that the optimum storage temp for flowering and seed production is in the 5–12°C range (1, 4, 5, 8). Boswell (1) reported that floral primordial formation is almost inhibited at 0° and optimum at 5–7°. Thompson and Smith (8) showed that the best seed stalk development resulted from bulbs stored at 5–10° and that higher temp reduced their development. Jones (4) and Jones and Emsweller (5) showed that bulbs stored between 7.5 and 12° produced plants that flowered earlier, had more seed stalks, and a higher seed yield than did bulbs stored at higher or lower temp. Proper bulb storage prepares the bulb for flowering and seed production that can result in higher seed yields than those obtained from bulbs stored at other than optimum conditions. Light affects bulb development (3, 6, 7, 9), and when applied to onion bulbs during storage influences date of flowering (2).

We report the effects of light and temperature treatments during bulb storage on traits associated with seed production in an open pollinated cultivar of onion.

Materials and Methods

Bulbs of 'Trapp's Downing Yellow Globe' onion grown at the Michigan State University Muck Farm during 1971 and 1972 were cured at 15–18°C for ca. 4 weeks before being selected for uniform size and randomly assigned to 1 of 9 light-temp treatments. Bulbs placed into controlled temp chambers in Oct., 1971 and 1972 and removed in April, 1972 and 1973, were stored for 179 and 174 days respectively. One storage chamber kept at 2° was dark while the chambers kept at 7° were partitioned into 3 sections to accommodate 3 light treatments: continuous light; a 12-hr photoperiod; and continuous dark. Two 40 W cool-white fluorescent lamps and one 40 W incandescent lamp suspended approx 60 cm above the bulbs provided a light intensity at bulb level of approx 1.6 klx. Bulbs in the chambers were arranged in an upright position in 1 layer on a flat surface to insure maximum light exposure. The chambers were partitioned in a manner which allowed uniform and constant air circulation between the 3 sections. Temp in each chamber section were monitored daily and no measurable differences were recorded between or within sections either at bulb level or approx 15 cm below the lights.

Halfway through the storage period some bulbs were transferred to other treatments for the remainder of the storage period as follows: 1) Some of the bulbs from all 3 light treatments at 7°C were placed in the dark at 2°; and 2) Some of the bulbs in the dark at 2° were placed into the 3 light treatments at 7°.

After storage, 40 bulbs from each treatment were randomly planted as a randomized block design with 2 replications within two 3.6 x 7.3 m lumite saran mesh cages. Bees were placed in the cages to effect pollination. The no. of leaves (1973 only), and seed-stalk height of each bulb was recorded at the opening of the first floret.

Table 1. Effects of temperature treatments during onion bulb storage on seed yield and related traits.

	Temperature treatment								
	7°C			1st half 7°C 2nd half 2°C			1st half 2°C 2nd half 7°C		
Trait	1972	1973	$\bar{x}$	1972	1973	$\bar{x}$	1972	1973	$\bar{x}$
Seed yield (g/plant)	10.3	11.1	**10.7[z]b**	13.1	12.1	**12.6a**	12.1	10.1	**11.1b**
Umbels/plant	3.3	4.2	**3.8a**	3.4	3.8	**3.6a**	3.3	3.3	**3.3a**
No. of seeds/umbel	807	699	**752.9b**	931	823	**877.0a**	903	768	**835a**
No. of seeds/plant	2626	2848	**2737b**	3199	3053	**3126a**	2932	2510	**2721b**
Seed wt (mg/seed)	3.9	3.8	**3.89b**	4.1	4.0	**4.0a**	4.1	4.0	**4.0a**
Seed stalk ht (cm)	89.2	96.3	**92.7b**	98.5	103.0	**100.8a**	98.6	98.0	**98.2a**
No. of leaves/plant	–	24.7	**24.7a**	–	24.8	**24.8a**	–	21.0	**21.0b**

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

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Umbels were harvested at maturity and dryed at 35°C for 1 week and the wt and no. of seed/umbel were recorded. Five random samples of 1000 seed from each treatment were taken to determine the average wt per seed.

Results and Discussion

Light treatments had no significant effect on the traits studied. Therefore, the data from the light treatments are not reported herein. However, there were significant storage temp effects on most of the traits studied and these data are reported in Table. 1.

Seed yield is presented as wt of seed/plant. The components of seed yield studied were the no. of umbels/plant, the no. of seed/umbel, the no. of seed/plant and the wt of individual seeds. In addition traits which could possibly affect seed yield such as seed stalk height and the no. of leaves/plant were also studied.

Seed yield (wt of seed/plant) differed with temp treatment. The greatest seed wt/plant was obtained from bulbs stored at 7°C the first half and 2° the second half of the storage period. Among the components which make up seed yield/plant, the number of seed/umbel, seed wt, and the no. of seed/plant were all highest in plants from bulbs which received the 7–2° bulb storage treatment. All these traits were significantly greater for the 7–2° treatment than for the continuous 7° treatment. The no. of seed/umbel and the wt of one seed from the 7–2° treatment did not differ from 2–7° treatment. The no. of umbels/plant was not affected by temp treatment. It appears that the no. of seed/plant is the major component affecting seed yield with the temp treatments used in this study. It is not known if the higher no. of seeds produced from bulbs stored at the 7–2° regime was a result of more florets being produced in each umbel, more seeds/floret or a greater no. of florets on each umbel that set seed.

Seed stalk height and the no. of leaves/plant were studied to determine if they were related to seed yield because of the possibility that a taller seed stalk or more leaves could produce sufficient photosynthate to affect the wt of individual seeds.

The tallest seed stalks were associated with the highest yields and the greatest no. of seeds/plant. However, this may not be a cause and effect relationship. In a previous study (2) seed stalk height was correlated with days required for flowering. The shortest seed stalks were found on those plants which flowered the earliest. When the umbel started to flower the growth of the seed stalk ceased. Possibly late flowering plants had more time for seed stalk growth and were taller.

The higher seed yields associated with the tallest seed stalks may be a result of indirect effects which we did not study. It is possible that the flowers on the taller seed stalks were visited more often by bees than those on shorter seed stalks, or that air circulation was better around the taller stalks. These things could aid in pollination, seed set and maturation. It is also possible that the taller seed stalks provided more photosynthate to the plant causing the wt of each seed to be greater than the wt of seed from plants with short seed stalks.

The no. of leaves/plant was influenced by storage temp in that the treatment of 2°C the first half and 7° the last half of storage resulted in plants with significantly fewer leaves than plants from the other temp regimes, indicating a temp effect on leaf primordial development during the first half of the storage period.

The no. of leaves was not associated with seed wt in that the plants with the fewest leaves had the same size seed as the plants from the 7–2°C treatment which had a greater no. of leaves.

This study supports the findings of others (4, 5, 8) that storage temp of the bulb affects onion seed production. In addition we have identified a storage temp regime associated with high seed yields which was apparently the result of an increased no. of seeds/plant. This increase in no. of seed was not associated with a decrease in seed wt. The temp treatment responsible for this increase in seed yield (7°C followed by 2°) is quite different from the storage treatment normally given to bulbs used for seed production. The treatments commonly used compare somewhat to the constant 7° treatment and the 2–7° of this study. The bulbs are normally stored at a constant temp or at a cool temp which increases during the latter part of the storage period as the outside air is warming. The 7–2° treatment also provides the high and low temp in a different sequence than that experienced in the production of onion seed using the seed-to-seed method in which the small bulbs are subjected to cold winter weather which warms in the spring. This is the first report that we are aware of that indicates that a warm storage temp (7°) followed by a cooler temp (2°) was conducive to high seed yields.

Different onion genotypes might respond differently to the temp treatments than did the open pollinated cultivar used. This aspect should be investigated further. In addition, the use of inbred onion lines for future studies of this type should make it possible to obtain more precise data on the effect of storage temp treatments on the traits associated with onion seed yields.

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