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Forcing Spring Bulbs in High Tunnels for Profitability

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Abstract
High tunnels are a relatively new concept primarily used by vegetable growers for season extension (both spring and fall, but mainly for early spring production). There also are a few Iowa growers raising strawberries and cut flowers. Almost any annual outdoor vegetable crop can be raised successfully in a high tunnel, but the key is profitability. A common structure is 30 × 96 ft and typically costs about $1.60 to $2.35/sq ft (with automatic side rollup). Some crops can be double cropped in a high tunnel (peppers, pole beans, and specialty cucumbers).

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Introduction

High tunnels are a relatively new concept primarily used by vegetable growers for season extension (both spring and fall, but mainly for early spring production). There also are a few Iowa growers raising strawberries and cut flowers. Almost any annual outdoor vegetable crop can be raised successfully in a high tunnel, but the key is profitability. A common structure is 30 × 96 ft and typically costs about $1.60 to $2.35/sq ft (with automatic side rollup). Some crops can be double cropped in a high tunnel (peppers, pole beans, and specialty cucumbers).

We propose looking at triple cropping in a season by using container tulip and daffodil bulbs for spring sales (Valentine's Day and Easter market), followed by two vegetable plantings. Forcing spring bulbs requires a 12- to 16-wk cold period where bulb zone temperatures are < 45°F, but above 32°F. This requires growers to maintain a chilling room or greenhouse area once the bulbs are potted. Limited winter temperature data from our bramble high tunnel project indicates a high tunnel may serve as the chilling room. A greenhouse grower might team up with a fruit/vegetable grower with a high tunnel to reduce production costs.

Tulip and daffodil bulbs are well known species for spring flower forcing in the horticulture industry. The main objective in forcing bulbs, rather than growing them under natural conditions, is to produce a flowering plant as early as possible for the spring market. Typical commercial forcing season begins in early December and ends in mid-May. The standard technique for early bulb forcing is by precooling the bulbs for up to six weeks at 7 to 9ºC, then placing them in an environment of 0.5 to 7ºC for 13–22 weeks to meet the bulb chilling requirement. Once the chilling requirement is fulfilled, the bulbs are then placed in a greenhouse at 21ºC for the final developmental stages of leaf expansion, scape elongation, and flower anthesis. The use of the polyethylene high tunnel was to meet the second phase of the bulb chilling requirements. The purpose of high tunnels is to reduce greenhouse costs and to produce a flowering crop that would compete with other crops for the same market.

Our objective was to evaluate the effectiveness of different temperature exposures within high tunnels on forcing potted Tulipa, Cracker, Narcissus, and February Gold.

Materials and Methods

Bulbs were stored in a refrigerator for two weeks at 4.4°C before being potted on November 14, 2008. Four bulbs, two of Cracker and two of February Gold, were placed 3 in. deep in each 5-in. Azalea pot and covered to the rim with potting media. The experimental design was a 2 × 2 factorial with four replications in a randomized block arrangement. Pot placement and covering were the two main treatments, and each of these treatments had two sublevels. For placement, variables were surface and trench (below ground level at approximately 8-in. depth). The two variables for covering were remay (a spunbonded polyester material) alone or remay plus 4 in. of straw. Pots were placed in treatments in the center of a polyethylene high tunnel facing east-west and watered thoroughly on November 14, 2008. Thermocouples were then placed in treatment plots of one replication between the inner three pots. Maximum and minimum temperatures were recorded daily and downloaded monthly.

Pots were transferred to the greenhouse on February 29, 2009 when chilling requirements were met and some treatments were beginning to germinate. Greenhouse temperature was kept consistently between 21°C and 29.5°C and 14 hour daylight (long days) was met with high pressure sodium lights. Data were collected twice a week starting March 3 through March 28. Data included emergence, height of growth, scape elongation, and presence/size of bloom. Observations were noted on guard pots for growth consistency and presence of bloom.

Results and Discussion

Emergence of tulip bulbs was complete after four days in the greenhouse. There was an interaction ($P = 0.015$) between pot placement depth and covering while in the high tunnel (Table 1). Surface placement had the lowest germination, 13%, compared with trench, 67%. However, placement had no effect on germination as long as the pots were covered with 4 in. of straw, > 88%. All daffodil bulbs emerged on the fourth day in the greenhouse, except for pots on surface placement with no straw. There was no effect on emergence by placement, averaging < 50%. However, straw covering had a significant effect ($P = 0.02$) by increasing emergence 4.7 fold compared with no cover (Table 2).

Both tulips and daffodils covered with straw grew taller than treatments without straw (Table 3). However, trench placement was effective in enhancing tulip shoot growth. There was no interaction between placement and covering.

Percent bloom indicates the presence of flower bud formation. Tulip bulbs with no straw covering started blooming on approximately the tenth day while those covered with straw commenced bloom on the thirteenth day. Straw covered pots had the highest bloom percentage, 56%, but this value is too low for acceptable marketing (Table 4). Placing the pots in a trench increased bloom percentage twofold, compared with surface placement, but only 40% of the bulbs bloomed. Adding straw covering to trench-placed pots did not increase bloom percentage.

Daffodil bulbs with straw started blooming on the tenth day and bulbs without straw never bloomed as the bulbs were killed by freezing temperatures (Table 4). Even with straw the 22% bloom value is unacceptable. Our results showed that deep placement alone did not provide enough protection for the potted bulbs. Using the straw covering did provide enough protection for the bulbs to meet the chilling requirements without freezing, but bulb performance indicated this technique was not a consistent way to force bulbs for the spring market.

Table 1. Emergence percent of tulip bulbs in greenhouse after 14 weeks in a high tunnel environment.

	Tulip cover	
Pot placement	None	Straw
Surface	13	88
Trench	67	96
Sign., std. error	15.4	

Table 2. Emergence percent of daffodil bulbs in greenhouse after 14 weeks in a high tunnel environment. Only the trench treatment data is presented as there was no emergence from surface placement.

Cover treatment	Daffodil emergence
No cover	13
Straw cover	61
Sign., P>F	0.02

Table 3. Growth as measured by shoot height, inches. There was no interaction of pot placement with cover treatments.

Treatment	Tulip	Daffodil
Pot placement		
Surface	3.61	1.17
Trench	6.27	2.17
Sign., P>F	0.02	ns
Straw cover		
No cover	2.02	0.59
Straw cover	7.87	2.75
Sign., P>F	<0.01	0.02

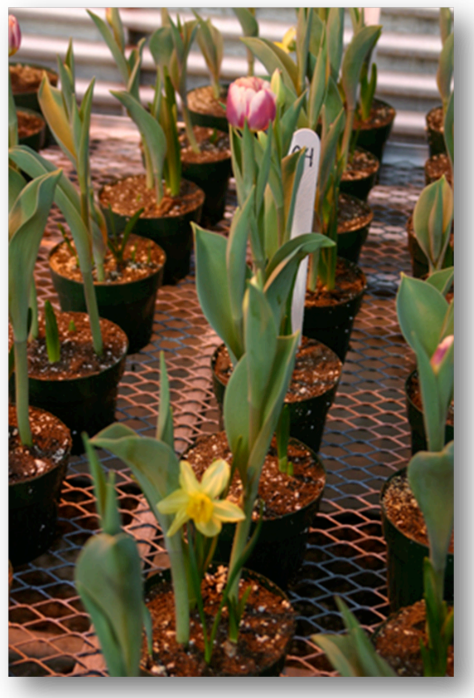
Table 4. Bloom as percentage. There was no interaction of pot placement with cover treatments.

Treatment	Tulip	Daffodil
Pot placement		
Surface	20.8	8.3
Trench	39.8	14.5
Sign., P>F	0.07	ns
Straw cover		
No cover	4.3	0.0
Straw cover	56.3	22.8
Sign., P>F	<0.01	0.002

Bulb pots in high tunnel in January 2009 to complete chilling requirement.

Bulb pot arrangement on greenhouse bench for growing out to bloom.

Initial germination of tulips.



Initial bloom of tulip and daffodils.