Cornell University
Cooperative Extension

Garlic Post-Harvest Study

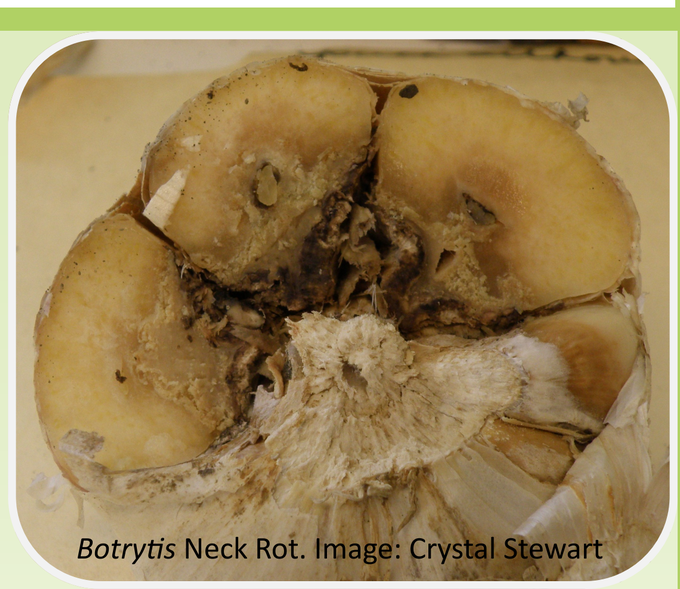
Year Two

Garlic is a 20 million dollar industry in New York, and it represents an important and growing niche crop across the Northeast. As production continues to expand it is increasingly important for growers to use the most effective methods to grow, dry, and store garlic in order to maximize quality. The results of this two-year study provide insights into which practices yield the best results.

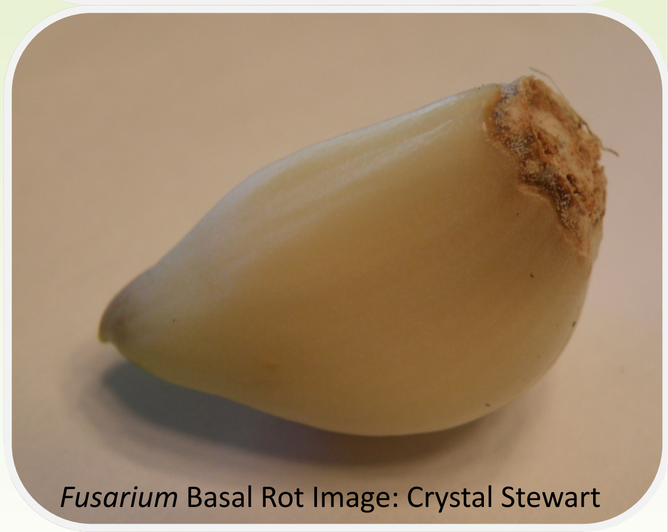
Aspergillus (black mold) Image: Crystal Stewart

Embellisia
Image: Crystal Stewart

Diseases such as Botrytis neck rot, Penicillium, and surface molds such as Embellisia Skin Blotch and Aspergillus are common in curing areas with variable moisture, such as barns and sheds. Effects of poor post-harvest treatment can be devastating. The simplest way to address issues with post-harvest diseases is to change the environment where garlic is cured. Based on the research available and consultation with the Garlic Seed Foundation, a series of treatments were developed to test this hypothesis:



Botrytis Neck Rot. Image: Crystal Stewart



Fusarium Basal Rot Image: Crystal Stewart

Hypothesis: Optimizing post-harvest handling of garlic will reduce post-harvest loss and improve seed stock.

Treatments used to test hypothesis:

A	Trim Roots flush with basal plate
B	Trim tops to 1.5” long
C	Trim tops to 6” long
D	Trim tops 10” long
E	Cure in High Tunnel
F	Cure in open-air structure
G	Leave Roots and tops un-cut

Treatments were applied either at harvest or as garlic was brought into the drying areas. Each treatment was replicated three times on either 30 bulbs or on set number of row feet. All top cutting treatments had the roots intact. Root pruned garlic was top pruned to the farm default height (approximately 6 inches on two farms; uncut on a third farm). All treatments were placed both in open air sheds and in the high tunnel.

Materials & Methods

Three farms were included in year two of the post-harvest study; one in the Hudson Valley and two in the Mohawk Valley Region. Based on last year's results, the washing treatment was removed from this year's trials and garlic stems were cut at three lengths: 1.5 inches, 6 inches, and 10 inches. Additional treatments were the same as in year one, and are detailed below. This year bulbs were selected for relative uniformity of size to reduce sample variation. Each treatment contained 30 bulbs and was replicated three times per farm.

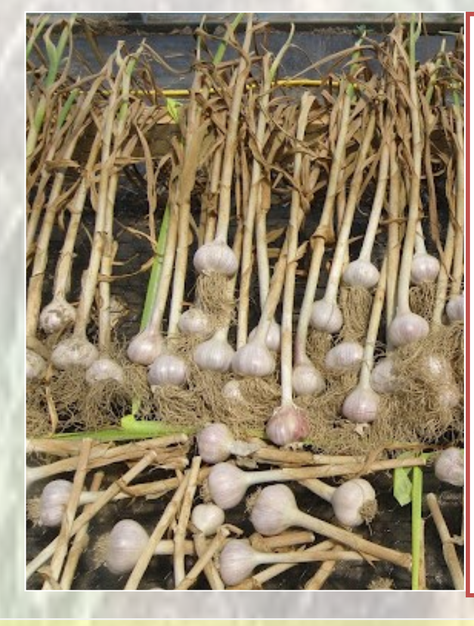
A. Root Pruning. Roots were cut shortly after harvest using shears. Care was taken not to damage the basal plate.

B. Top cutting at 6-10 inches: Garlic was cut with shears or a sickle-bar mower to a height of 6 or ten inches. Garlic was re-cut when cleaned and weighed.

C. Top cutting at 1.5 inches: Garlic was cut with a pruning shear to 1.5 inches from the top of the bulb. This treatment was added to see if the garlic could be cut just once before sale to reduce the amount of labor used.

D. Curing in high tunnels: Garlic was moved to high tunnels immediately after other treatments were completed. All high tunnels had a shade cloth and were ventilated with fans, preventing temperatures from exceeding 110 degrees F.

E. Open-Air Curing: These treatments were placed in solid but well-ventilated buildings such as barns and sheds to dry without supplemental heat from the sun.



F. **Leaves roots and tops uncut:** Garlic was left completely uncut in this treatment. It was spread out on drying racks to leave space for the bulbs to be one layer deep or it was tied into bundles of 6-10 and hung.

About High Tunnel Drying

The high tunnel drying temperatures for this year were maintained as close to 110° F as possible during the day. Temperatures were at times lower due to cloudy conditions or to accommodate workers. When temperatures exceeded 110° F tunnels were vented using roll-up sides or built in ventilation fans. It is important that garlic never be allowed to exceed 121°F, the temperature at which waxy breakdown is initiated. Growers took care not to approach this temperature.

Even when not externally vented, both high tunnel drying systems included internal fans to move air throughout the tunnel, keeping temperature and humidity relatively uniform. Night time temperatures were the same as external temperatures. Both growers who used high tunnels closed up the structures at night to exclude humidity. Both also employed dehumidifiers at night in the high tunnels.

Both high tunnel drying systems used shade cloths to regulate temperature and to protect the garlic. One to two layers of shade cloth were used to cover the parts of the high tunnel which contained garlic. Sun damage was not observed in either tunnel.

Results


Image: Crystal Stewart

High Tunnel vs. Open Air: Across six trials conducted over two years, high tunnels consistently dried garlic more quickly (by an average of 3 days); yielded garlic with less Aspergillus, Botrytis, and Embellisia; and importantly high tunnels never damaged any of the garlic that was dried in them. The addition of dehumidifiers at night in the closed high tunnels removed an additional 10-15 gallons of water from the air each night, further speeding the drying process. *Image: Botrytis porri on garlic from open-air shed drying system.*

Tops trimmed vs. tops untrimmed: Trimming the tops mechanically in the field greatly increased the speed of harvest and reduced the space needed for drying. Top trimming did not have a significant effect on disease incidence in cured bulbs, but in year one there were differences in bulb weight at two of the farms, with un-cut bulbs being slightly heavier (Table 1). During year two this weight difference was not observed (Table 2). The selection of relatively uniform starting bulbs may have reduced variability in year two and yielded more reliable results.

Table 1: Bulb weight comparison from year one-tops cut at 6 inches

Treatment	Average weight/ head	Count
Cut at 6”	0.113	1036
Uncut	0.130	972

Table 2: Bulb weight comparison from year two—more cutting lengths are included

Treatment	Weight/bulb	Count	Average weight/head
10 inch	24.4	206	0.118
1.5 inch	23.7	183	0.129
6 inch	22.7	186	0.122
Uncut	39.4	302	0.130

Roots trimmed vs. roots untrimmed: No statistically significant differences were observed between these treatments in regards to bulb quality, weight, or disease incidence. Roots can be pruned any time during the drying process.

Washed vs. unwashed: Washed garlic looked very good initially, but became more discolored than the unwashed garlic during the drying and curing process. Most discoloration could be removed by removing 1-3 wrapper leaves, but this extra step is time consuming. Disease incidence, particularly Aspergillus and Embellisia, was slightly higher in washed garlic. This treatment was not repeated in year two due to the lack of benefits.

Images, from left to right: root and stem pruning treatments arranged in an open air drying system, 10-inch stem-pruned garlic dried in a high-tunnel, a bulb with slightly loose wrapper leaves and a small amount of fungal infection within the scape stem from an open air drying system, and a pair of razor blade anvil pruners, the preferred tool for both root and stem pruning.

Next Steps:

The next step in maximizing post-harvest handling is the examination of longer-term storage conditions to determine optimum temperature and humidity ranges to maintain dried garlic weight while minimizing disease incidence.

For more information on this study please contact:

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Eastern NY Commercial Horticulture Program

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