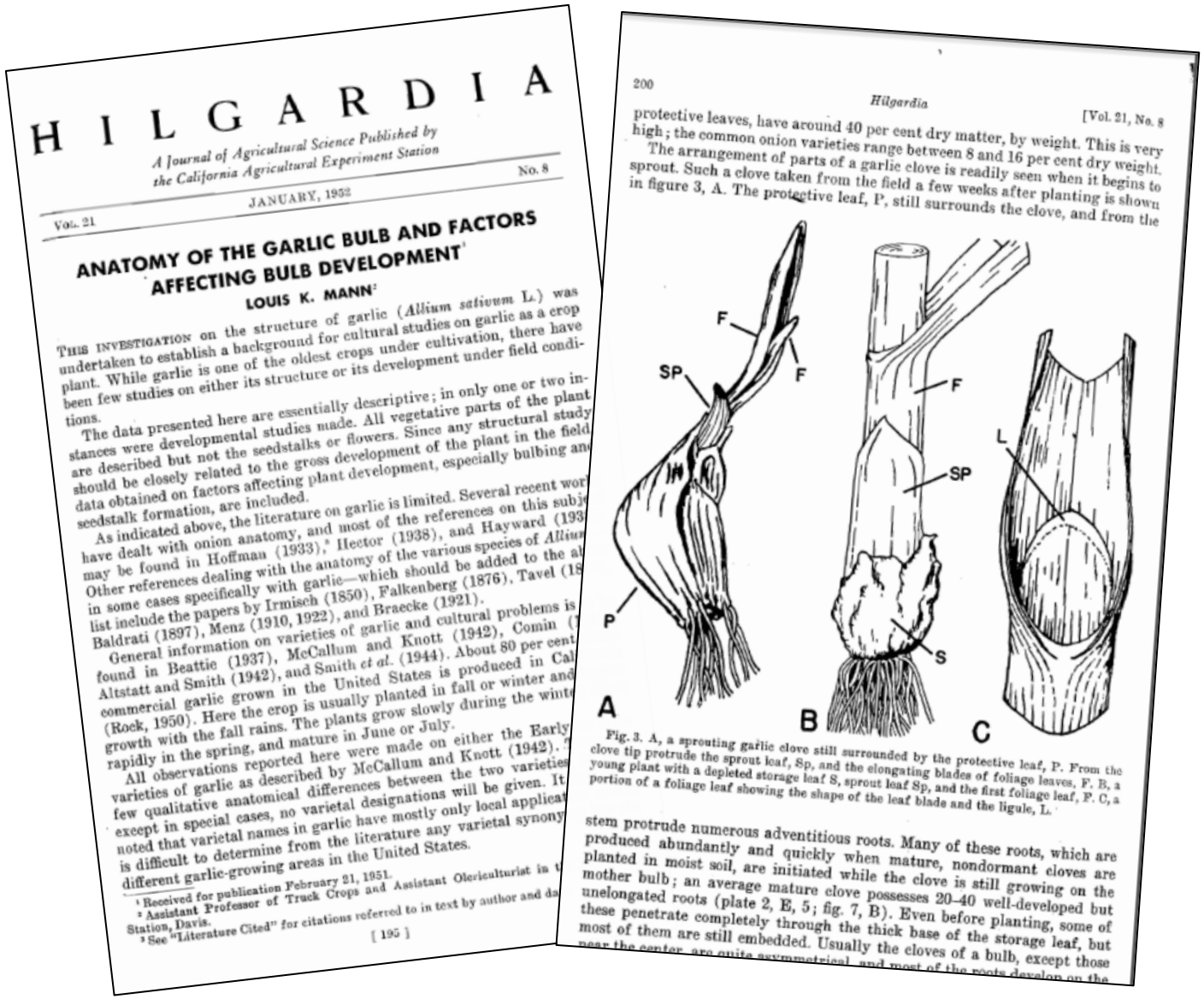
Postharvest Garlic Trials

March 22, 2022

Chris Callahan
UVM Extension Ag Engineering
go.uvm.edu/**ageng**
@uvmextageng

THE UNIVERSITY OF VERMONT AGRICULTURE & LIFE SCIENCES

NORTHEAST SARE Sustainable Agriculture Research & Education



HILGARDIA

A Journal of Agricultural Science Published by the California Agricultural Experiment Station

Vol. 21 JANUARY, 1952 No. 8

ANATOMY OF THE GARLIC BULB AND FACTORS AFFECTING BULB DEVELOPMENT[1]

LOUIS K. MANN[2]

THIS INVESTIGATION on the structure of garlic (*Allium sativum* L.) was undertaken to establish a background for cultural studies on garlic as a crop plant. While garlic is one of the oldest crops under cultivation, there have been few studies on either its structure or its development under field conditions.

The data presented here are essentially descriptive; in only one or two instances were developmental studies made. All vegetative parts of the plant are described but not the seedstalks or flowers. Since any structural study should be closely related to the gross development of the plant in the field, data obtained on factors affecting plant development, especially bulbing and seedstalk formation, are included.

As indicated above, the literature on garlic is limited. Several recent workers have dealt with onion anatomy, and most of the references on this subject may be found in Hoffman (1933),[3] Hector (1938), and Hayward (1938). Other references dealing with the anatomy of the various species of *Allium* in some cases specifically with garlic—which should be added to the above list include the papers by Irmisch (1850), Falkenberg (1876), Tavel (1887), Baldrati (1897), Menz (1910, 1922), and Braecke (1921).

General information on varieties of garlic and cultural problems is found in Beattie (1937), McCallum and Knott (1942), Comin (1950), Altstatt and Smith (1942), and Smith *et al.* (1944). About 80 per cent of commercial garlic grown in the United States is produced in California (Rock, 1950). Here the crop is usually planted in fall or winter and grows with the fall rains. The plants grow slowly during the winter, rapidly in the spring, and mature in June or July.

All observations reported here were made on either the Early varieties of garlic as described by McCallum and Knott (1942). There are few qualitative anatomical differences between the two varieties except in special cases, no varietal designations will be given. It is noted that varietal names in garlic have mostly only local application and it is difficult to determine from the literature any varietal synonymy between different garlic-growing areas in the United States.

[1] Received for publication February 21, 1951.

[2] Assistant Professor of Truck Crops and Assistant Olericulturist in the Station, Davis.

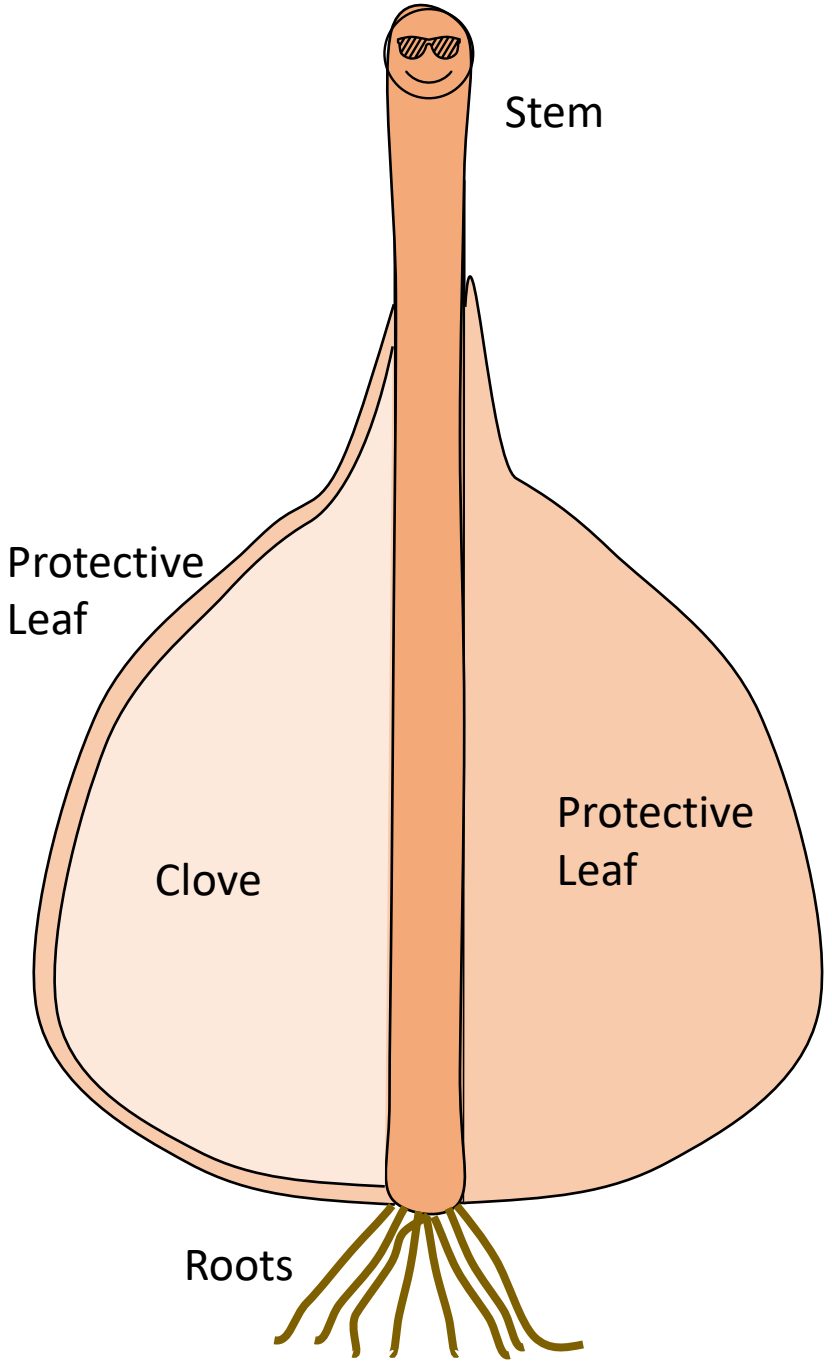
[3] See "Literature Cited" for citations referred to in text by author and date.

protective leaves, have around 40 per cent dry matter, by weight. This is very high; the common onion varieties range between 8 and 16 per cent dry weight.

The arrangement of parts of a garlic clove is readily seen when it begins to sprout. Such a clove taken from the field a few weeks after planting is shown in figure 3, A. The protective leaf, P, still surrounds the clove, and from the

Fig. 3. A, a sprouting garlic clove still surrounded by the protective leaf, P. From the clove tip protrude the sprout leaf, Sp, and the elongating blades of foliage leaves, F. B, a young plant with a depleted storage leaf S, sprout leaf Sp, and the first foliage leaf, F. C, a portion of a foliage leaf showing the shape of the leaf blade and the ligule, L.

stem protrude numerous adventitious roots. Many of these roots, which are produced abundantly and quickly when mature, nondormant cloves are planted in moist soil, are initiated while the clove is still growing on the mother bulb; an average mature clove possesses 20–40 well-developed but unelongated roots (plate 2, E, 5; fig. 7, B). Even before planting, some of these penetrate completely through the thick base of the storage leaf, but most of them are still embedded. Usually the cloves of a bulb, except those

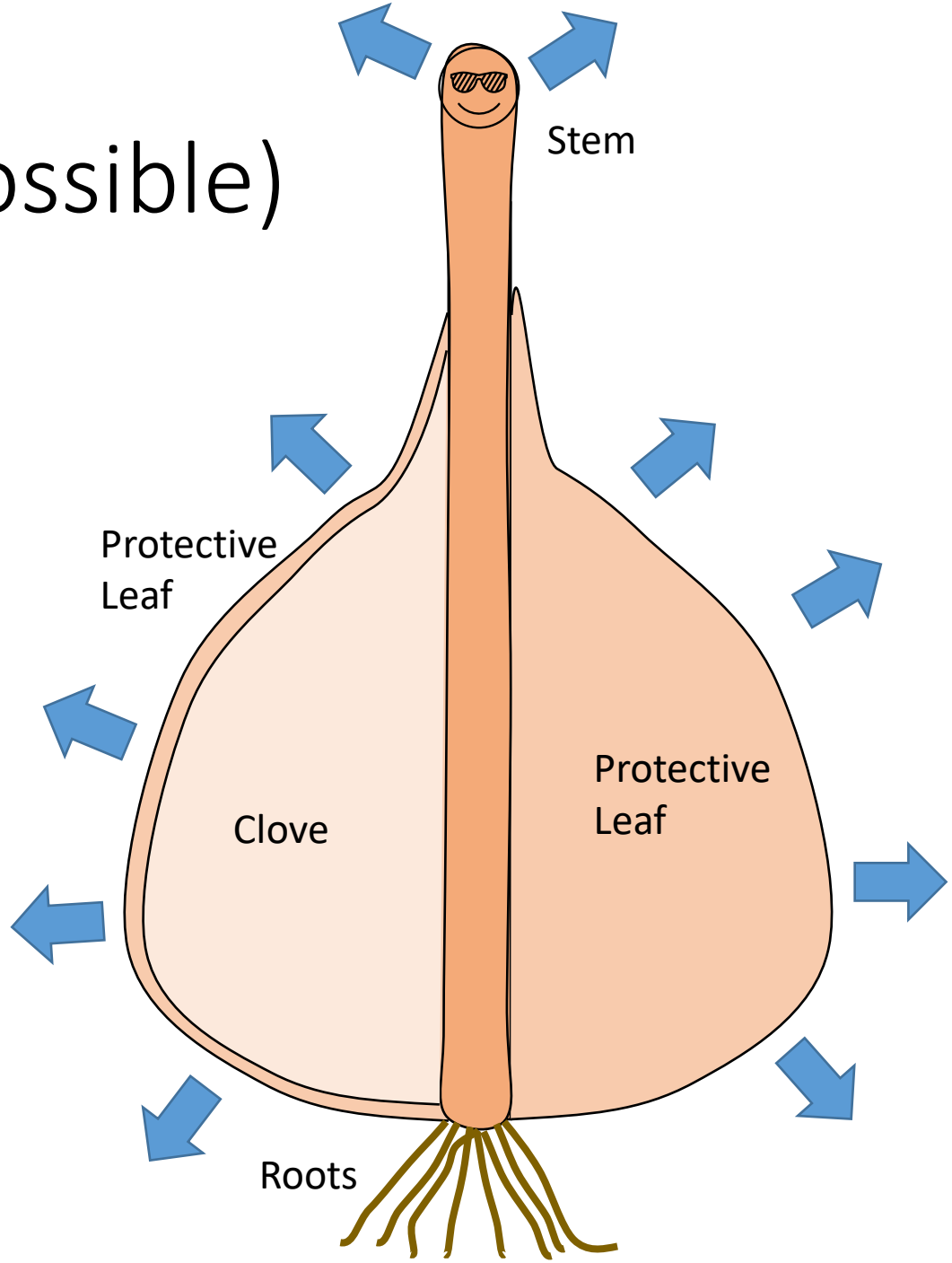


Mann, L. (1952). Anatomy of the Garlic Bulb and Factors Affecting Bulb Development. *Hilgardia - A Journal of Agricultural Science Published by the California Agricultural Experiment Station*, *21*(8), 195–231.

The Mission (Somewhat Possible)

- Dry down the stem, roots and protective leaves
- Shrink the neck
- Reduce water (mass) loss pathways
- Reduce water available for fungal and other pests and diseases in storage

- A papery “suit of armor”



Garlic Curing and Storage Trials

July 23, 2020

Harvest, Received

Curing Trials Begin

July 30 – Sept 9, 2020

Curing Trials End

25% mass loss for S1 & S2

35% mass loss for S3

Sept 9, 2020

Storage Trials Begin

April 7, 2021

Storage Trials End

- Mass Loss
- Visual quality
- Fusarium
- Mites

Curing Trials				
	Chamber 1	Chamber 2	Chamber 3	Chamber 4
	Treatment C1	Treatment C2	Treatment C3	Treatment C4
	80 F / 90 % RH	80 F / 70 %RH	105 F / 90 %RH	105 F / 70 %RH
S1 - Primary Sub-sample 1 - Large, trimmed 2-3"	Sample 1	Sample 1	Sample 1	Sample 1
S2 - Primary Sub-sample 2 - Medium, trimmed 2-3"	Sample 2	Sample 2	Sample 2	Sample 2
S3 - Primary Sub-sample 3 - Mixed, trimmed 6-7"	Sample 3	Sample 3	Sample 3	Sample 3
Storage Trials				
	Chamber 1	Chamber 2	Chamber 3	Chamber 4
	Treatment S1	Treatment S2	Treatment S3	Treatment S4
	32 F / 70 RH	32 F / 90 RH	65 F / 70 RH	65 F / 90 RH
Population 1 - Large, trimmed close	S1/C1, C2, C3, C4	S1/C1, C2, C3, C4	S1/C1, C2, C3, C4	S1/C1, C2, C3, C4
Population 2 - Medium, trimmed close	S2/C1, C2, C3, C4	S2/C1, C2, C3, C4	S2/C1, C2, C3, C4	S2/C1, C2, C3, C4
Population 3 - Mixed longer stem	S3/C1, C2, C3, C4	S3/C1, C2, C3, C4	S3/C1, C2, C3, C4	S3/C1, C2, C3, C4

Garlic Curing Trials

Cured and weighed each sample until completion of curing was confirmed with visual qualitative measures.

Also confirmed by noting when mass loss started to flat line (asymptote).

- 25-27% total mass loss from drying for S1 and S2 sub-samples (trimmed to 2-3”)
- 37-40% total mass loss from drying for S3 sub-samples.

The total curing time (hours) varied between primary sub-samples and treatments as follows.

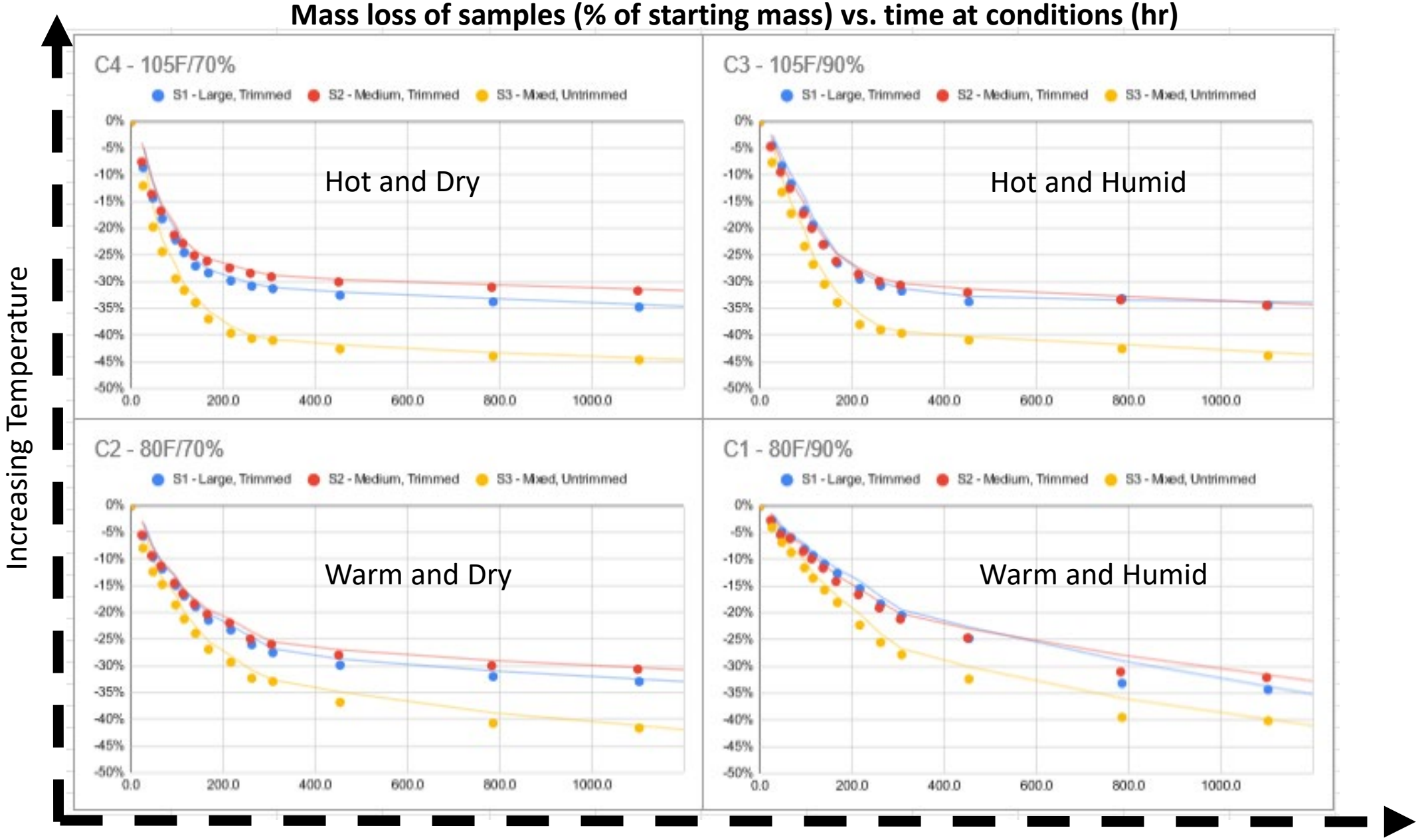
	S1 - Primary Sample 1 Large, trimmed 2-3"	S2 - Primary Sample 2 Medium, trimmed 2-3"	S3 - Primary Sample 3 Mixed, trimmed 6-7"
Treatment C1 Cool and Humid 80 F / 90 % RH	454	451	785
Treatment C2 Cool and Dry 80 F / 70 %RH	262	259	452
Treatment C3 Warm and Humid 105 F / 90 %RH	168	165	217
Treatment C4 Warm and Dry 105 F / 70 %RH	140	137	168

Summary:

- **Conditions determine curing duration: 6 – 33 days**
- **Consider using a weighed sample to determine curing completion**

CURING

Mass loss of samples (% of starting mass) vs. time at conditions (hr)

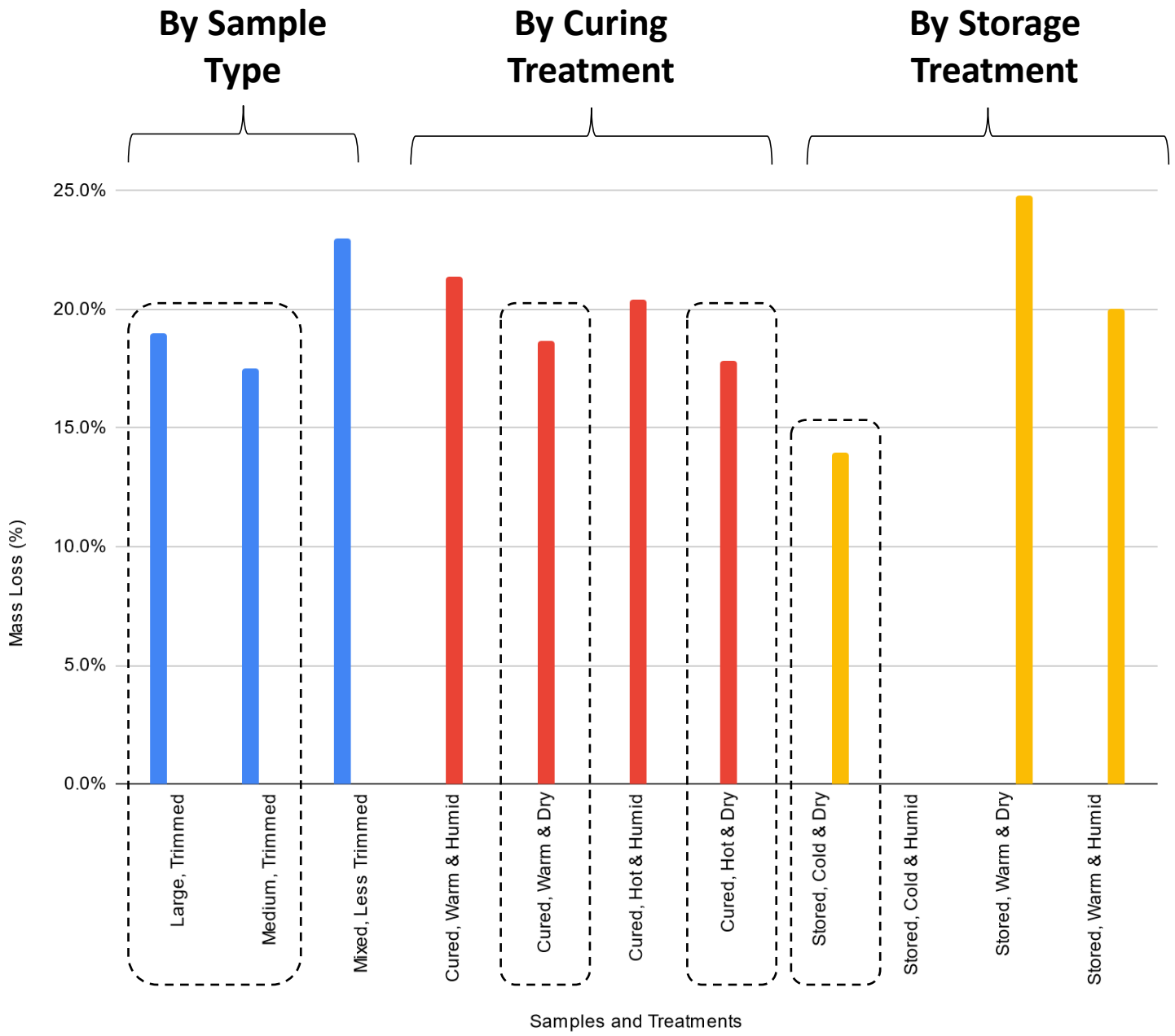


C. Callahan, UVM, 2022 03 22

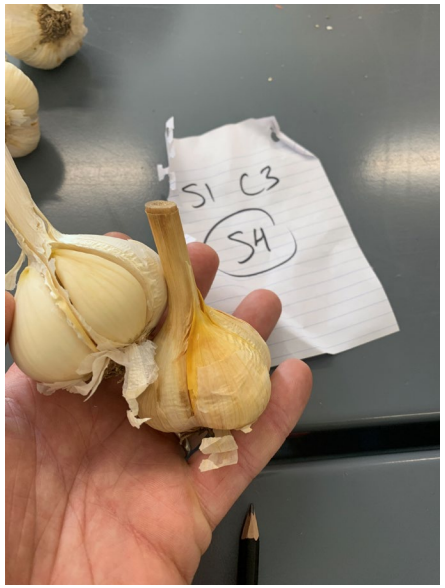
Storage Trials

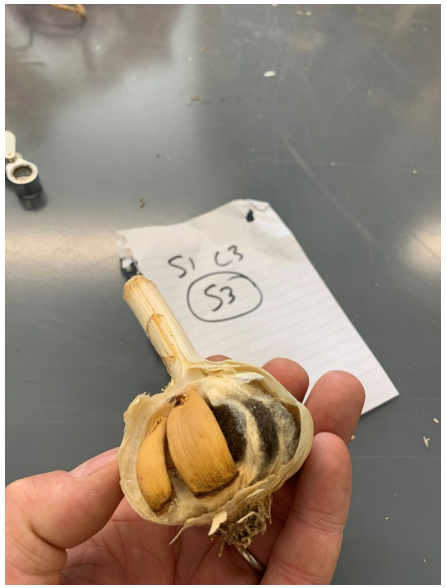
204 days (Sept-April)

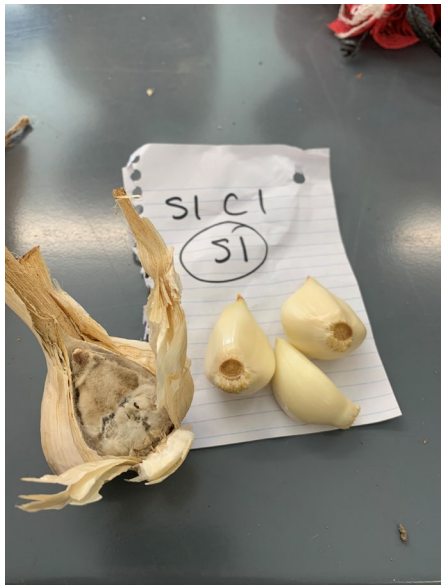
- Closer trimmed samples lost less mass in storage
- Samples cured in dry conditions lost less mass in storage
- Samples stored in cold & dry conditions lost less mass in storage



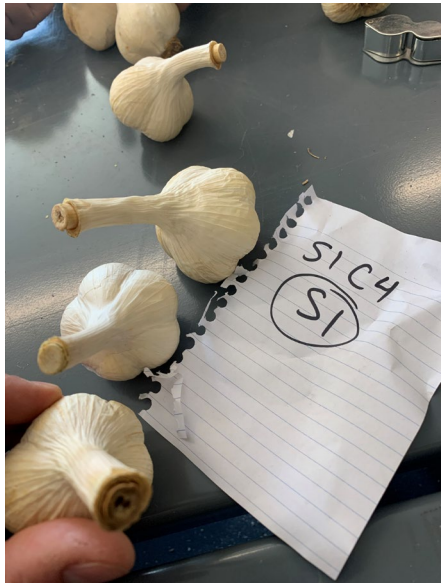

S1 C1
S3

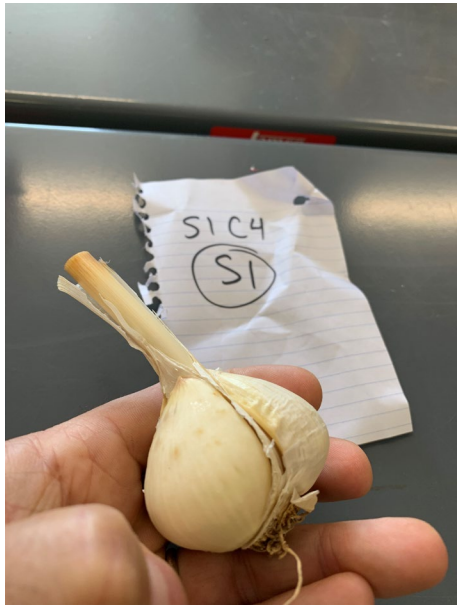

S1 C3
S4

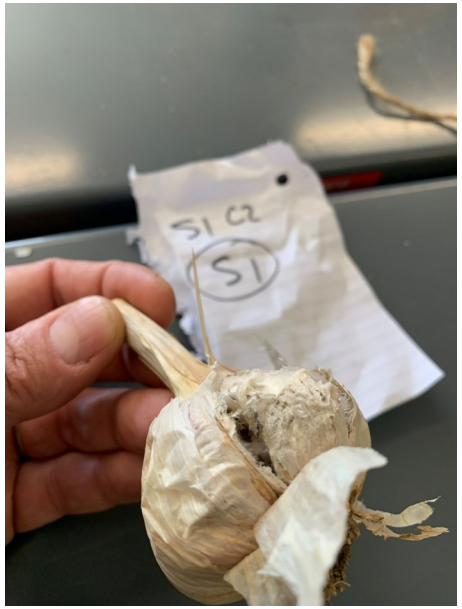

S1 C3
S3


S1 C1
S1


1C1C4

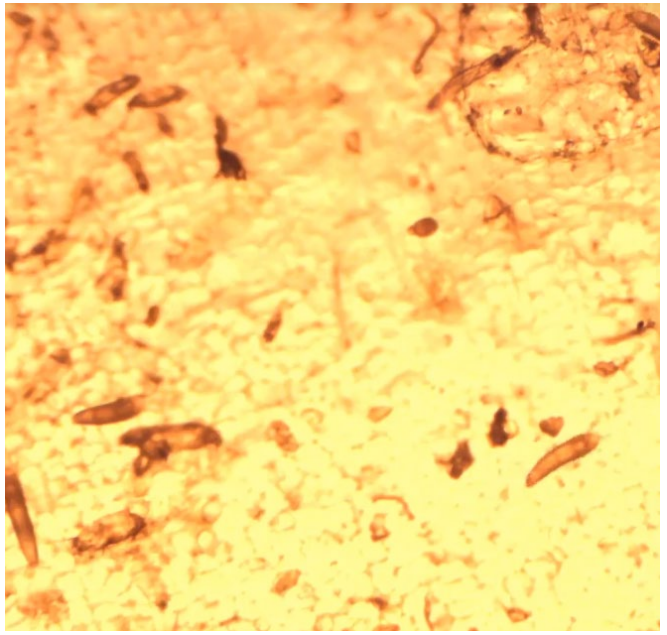

S1C4
S1


S1C4
S1


S1 C2
S1

All Together, Now…

Crystal's super scientific "percent marketable test"



	All Sample 1 - Large, Trimmed			
	Cured Warm, Humid (80 F, 90%RH)	Cured Warm, Dry (80 F, 70%)	Cured Hot, Humid (105 F, 90%)	Cured Hot, Dry (105 F, 70%)
Stored Cold, Dry (32F, 70%RH)	0%	86%	84%	87%
Stored Warm, Dry (60F, 70%)	60%	36%	59%	57%
Storage Warm, Humid (60F, 90%)	24%	82%	43%	63%

Using Forced Air Curing

- Use a blower and a plenum to circulate air.
- Ensures more consistent conditions.
- Expedites curing process.
- Prevents condensation.

go.uvm.edu/**forcedaircooling**