Cooperative Chestnut Breeding in the USA

Greg Miller
Empire Chestnut Company
Route 9 Cooperative

Premise

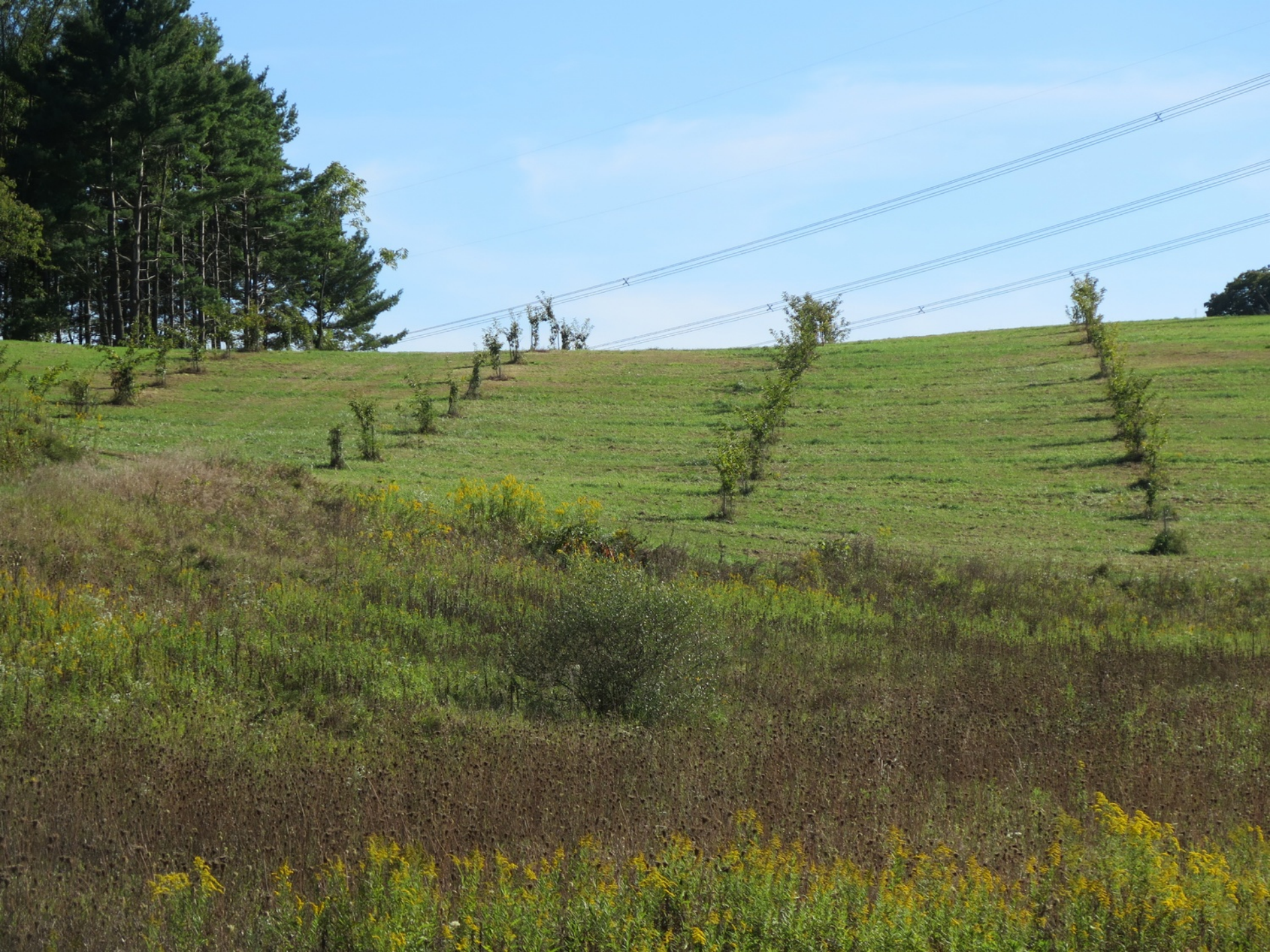
1. Demand for domestically-produced chestnuts in the USA exceeds supply. Therefore, growers are investing in new plantings.
2. Existing orchards and available nursery stock have not yet captured the genetic potential of the genus. Existing material is obsolete; there is substantial room for improvement.
3. By planting offspring from the best available parents, new plantings can be used as seedling trials and progeny tests, while profitably producing more and better chestnuts for sale.

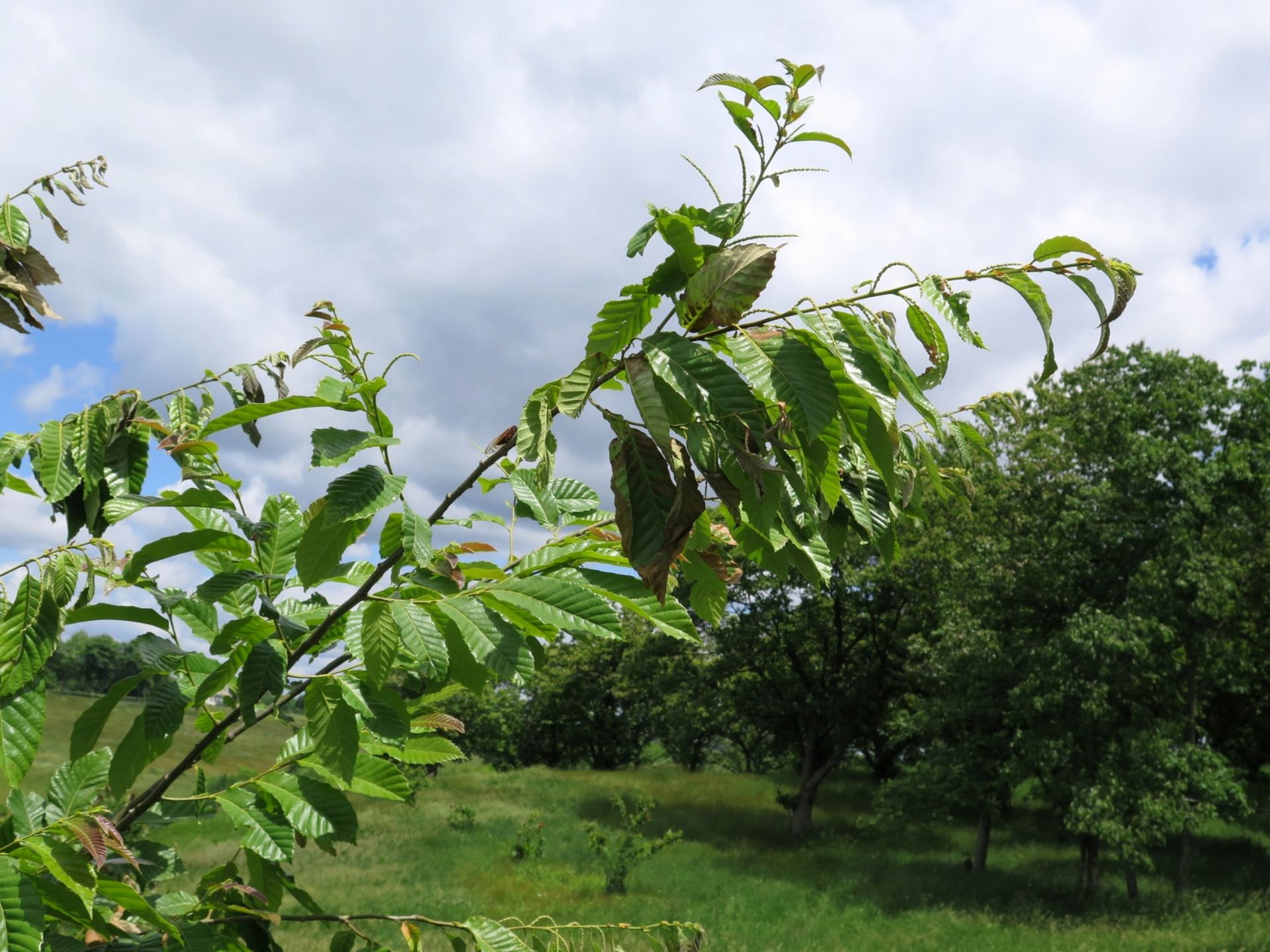
History

- After 30 yrs of collecting, evaluating, and collaborating, I arrived at the following.
- The gene pool for breeding chestnuts is huge, overwhelmingly huge, incl 7 species.
- For eastern North America, the anchor species is the Chinese, *Castanea mollissima.* It exhibits the best overall characteristics.
  - Highly variable: Selection within
  - Defects: Vegetative propagation, yield
- Hybrids can bring in improvements, but also hybrid dysgenesis, incl. internal kernel breakdown (IKB)

Current Status

- A number of good Chinese cultivars have been identified.
- A number of good Chinese parents have been identified.
- A large portion of offspring from good parents perform as well as good cultivars. This allows the success of seedling orchards.





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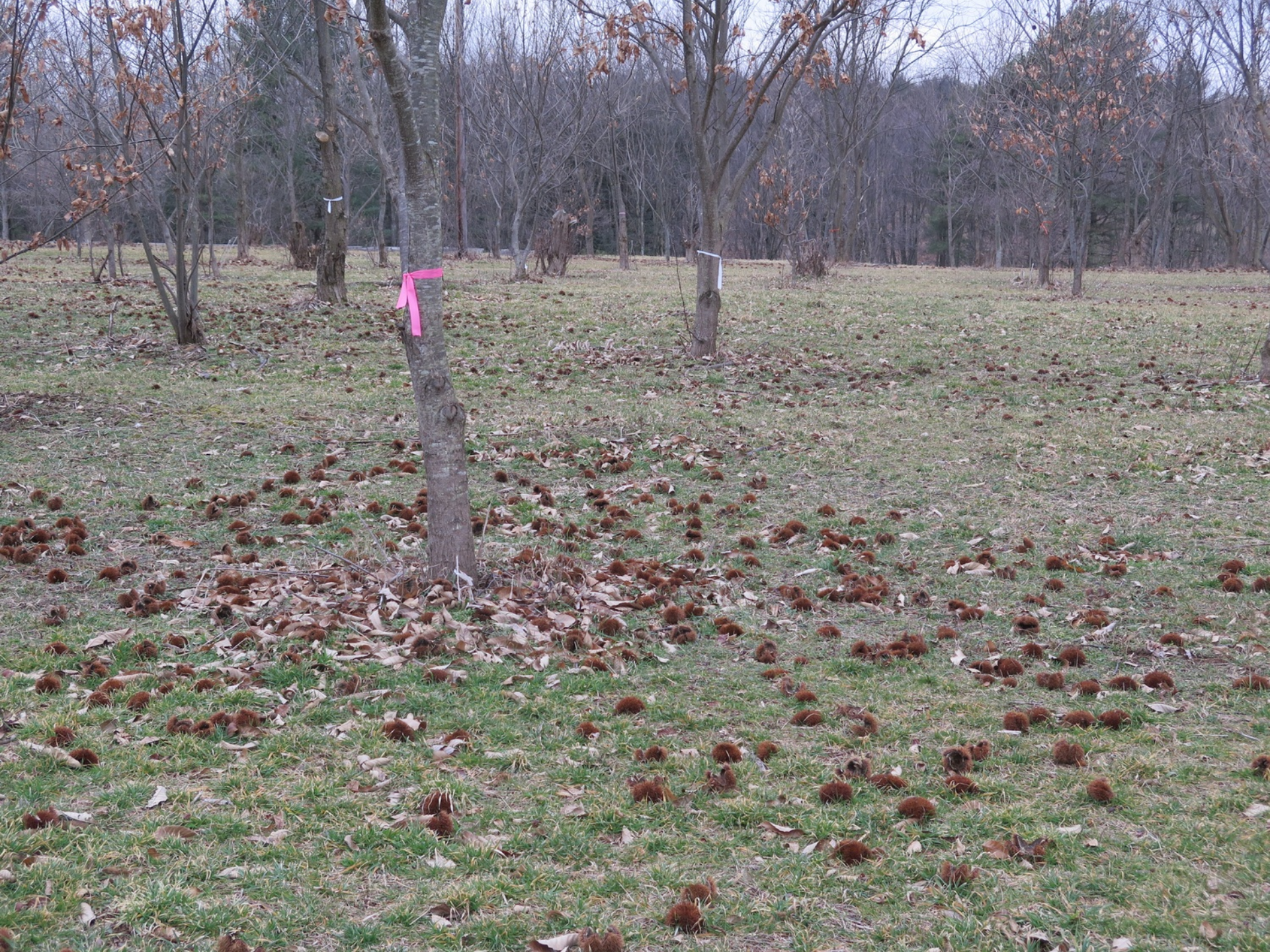
- Chinese cultivars and seedlings seem to yield less than other species or hybrids (esp Euro-Japanese hybrids).
- The biggest problem affecting chestnut marketing is kernel deterioration, esp fungal decay.

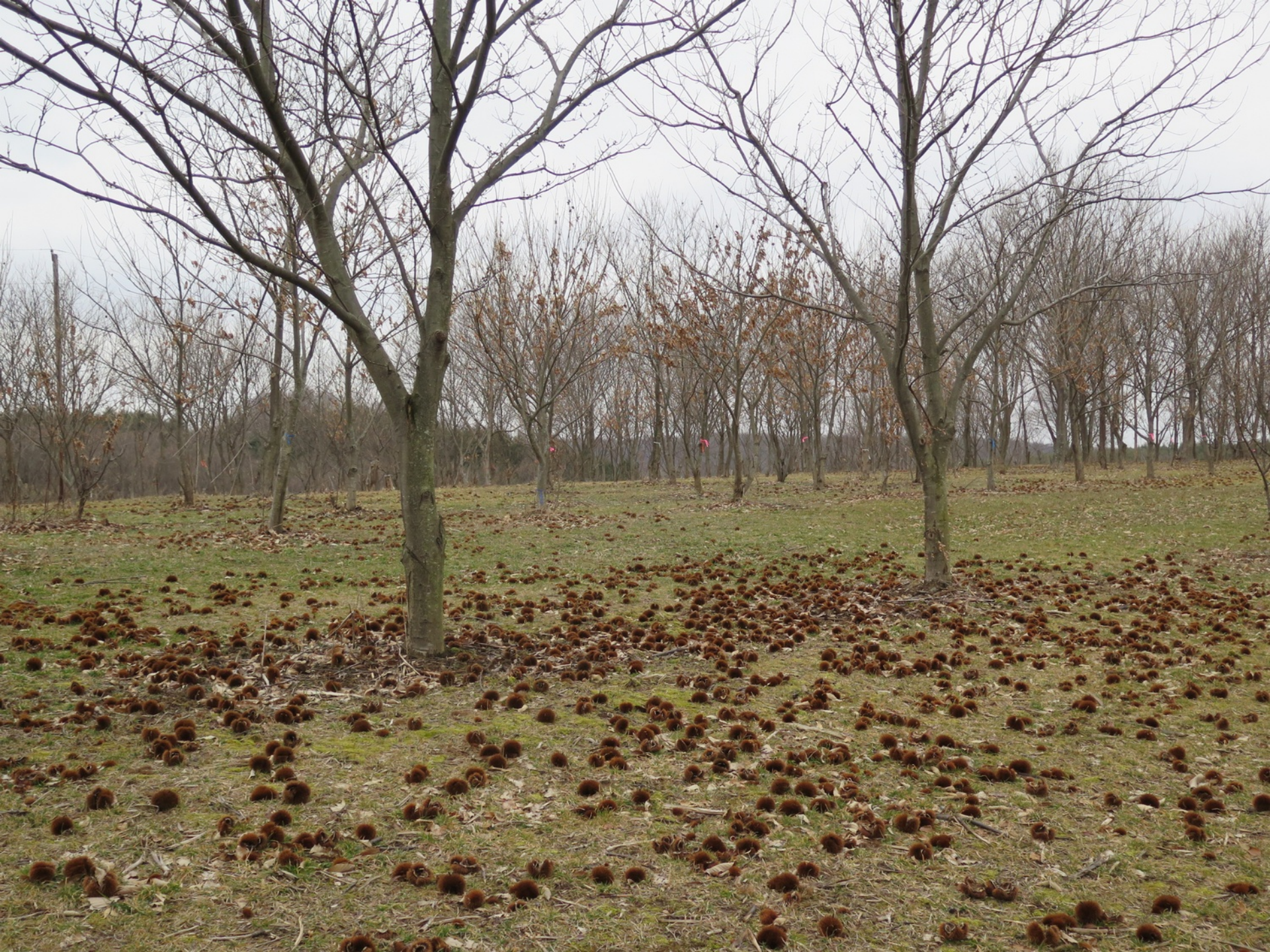
Yield

- Direct selection for yield is slow and inefficient.

- Yield Components:
  g/nut
  nuts/bur
  burs/fruiting shoot
  fruiting shoots/tree
  trees/hectare

  - From a breeding standpoint, burs/shoot is the primary variable (selectible) component.
  - Fruiting shoots/tree is dependent on tree size, but is also related to crown architecture and growth rate which are genetically variable.





Yield

- It's easy to find Chinese chestnuts that have a large number of burs/shoot. However, when the number of burs exceeds 3-4 per shoot, nut size and/or nut filling goes down

- Thus, there appears to be compensation which results in a **yield ceiling**.

- Some cultivars have a **higher yield ceiling**, esp male-sterile hybrids and some European and Japanese cultivars, esp hybrids. Why not pure Chinese?

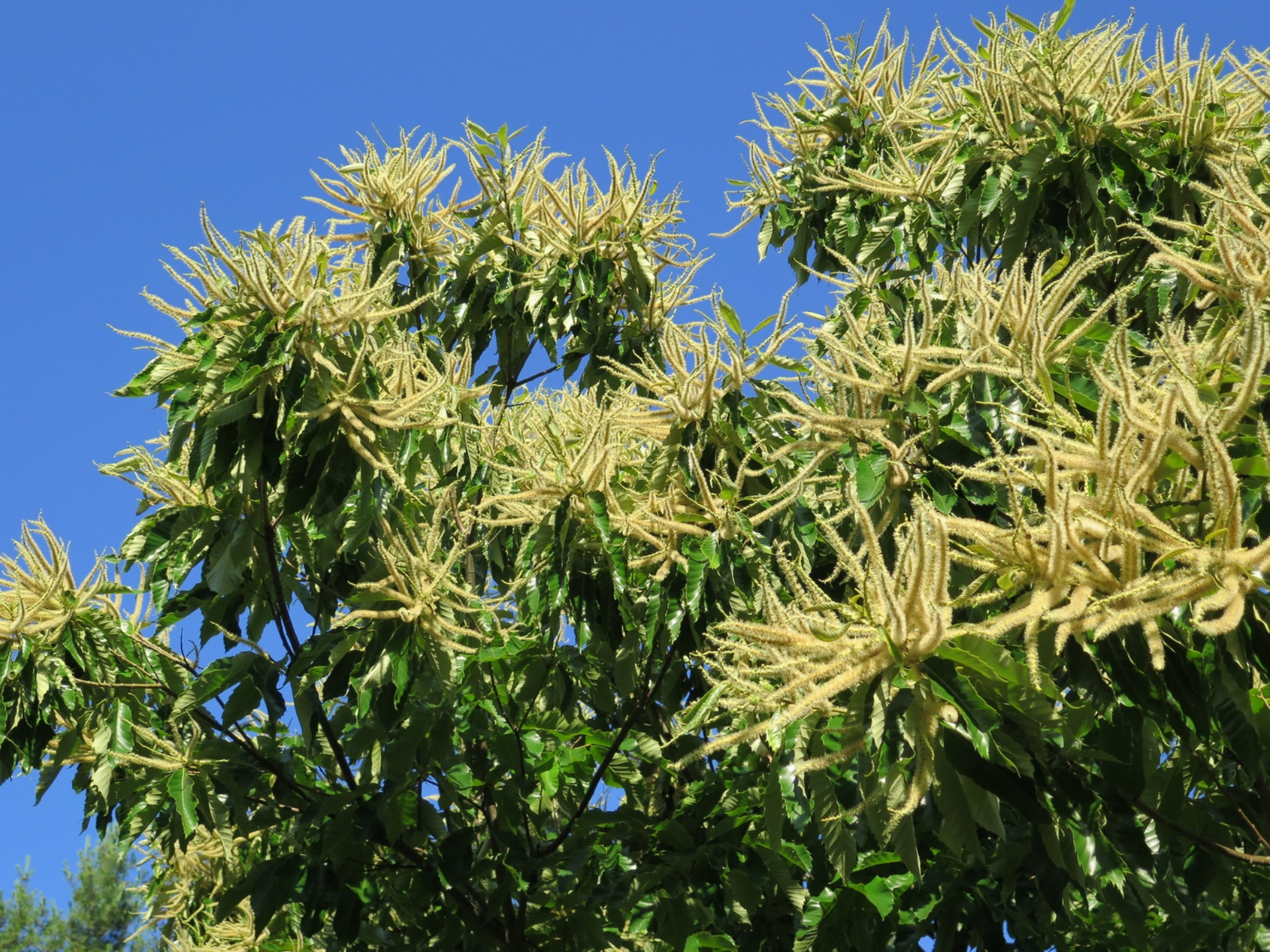
Yield

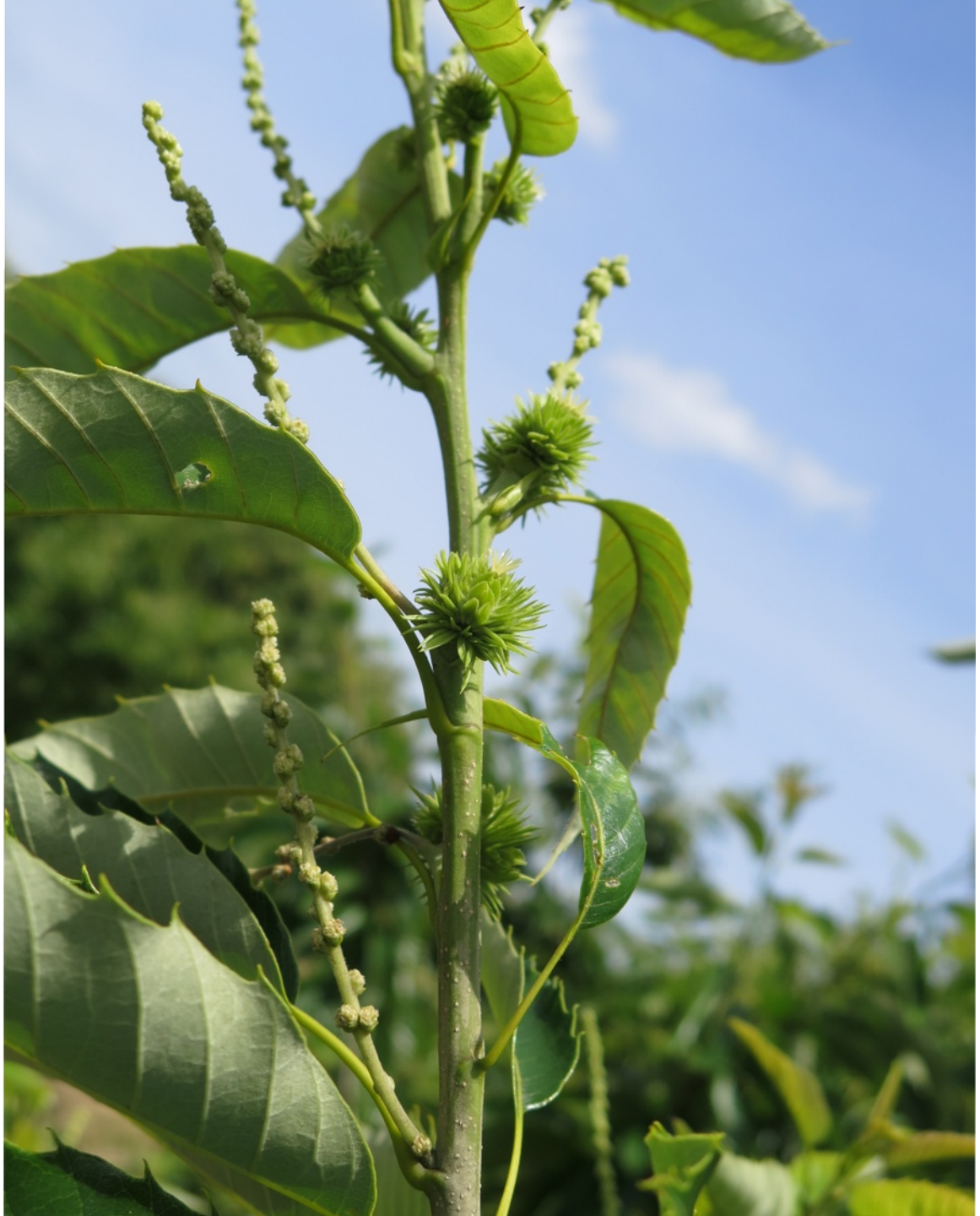
- Looking at early yield data from U of MO, two of the highest yielding cultivars are ‘Luvall’s Monster’ and ‘Colossal’, both of which are male sterile. Also, many (but not all) of the high-yielding European cultivars are male sterile.

- Chinese researchers found that removing small, immature male catkins results in substantially increased yield.

- It thus appears that the copious pollen production of typical Chinese chestnuts may lower the yield ceiling.

- Chinese chestnuts produce at least 10X (guess) more pollen than they need for nut set.





Reduce Pollen To Increase Yield

- Populate the orchard with 90% male sterile trees and 10% pollenizers.
  - ‘Luvall’s Monster’ produces nothing but male sterile offspring when pollinated by Chinese chestnuts.

- Populate the orchard with male fertile trees that produce 10% of the “normal” number of male flowers and twice the “normal” number of female flowers.

- Remember 2 male-sterile cultivars: **‘Luvall’s Monster’** and **‘Ace’**

High Yield Resulting from Vigor

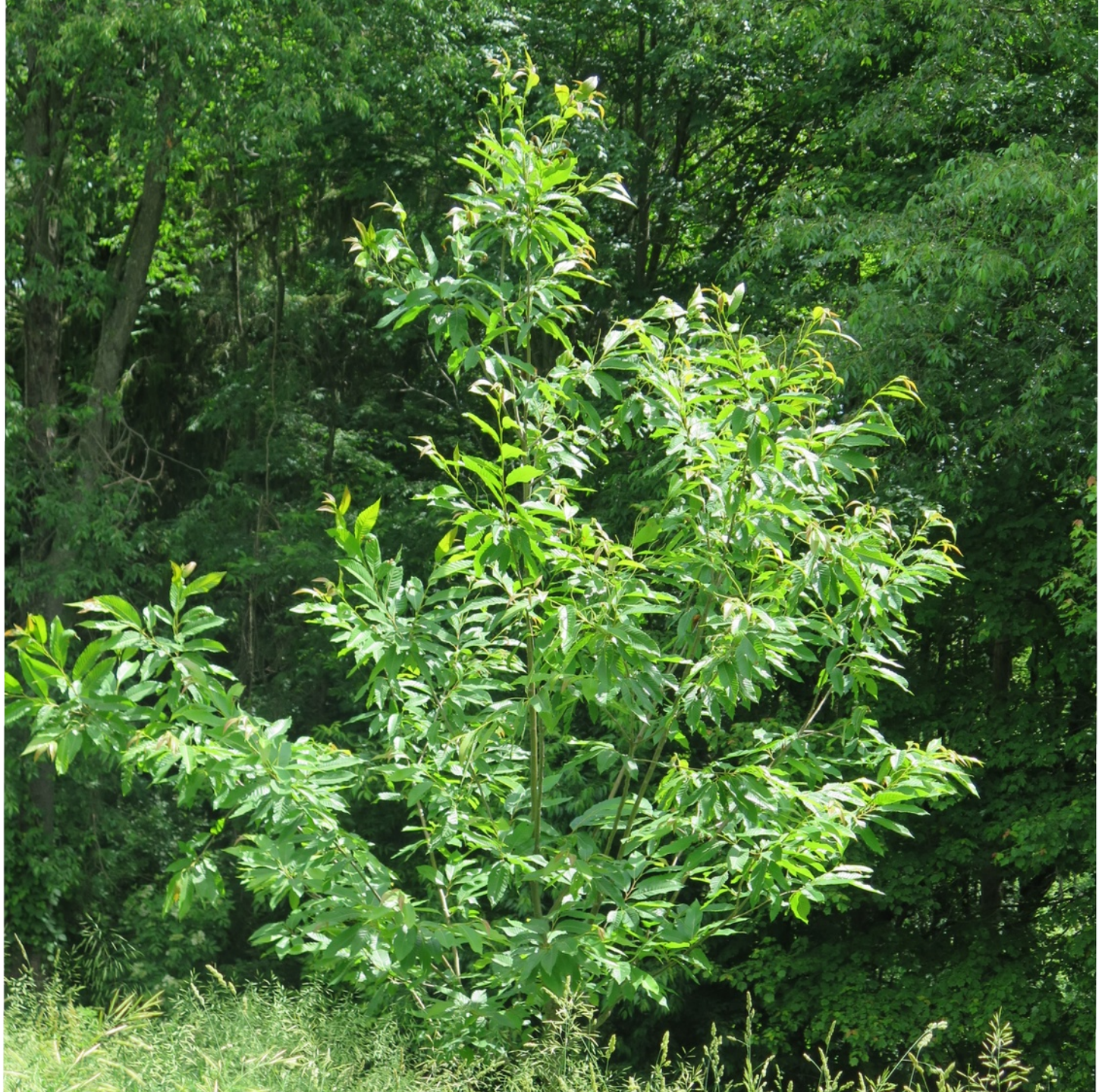
- Highly productive cultivars tend to be vigorous growers with thick twigs, large leaves, and a “loose” crown structure. Productive cultivars are not necessarily male sterile.

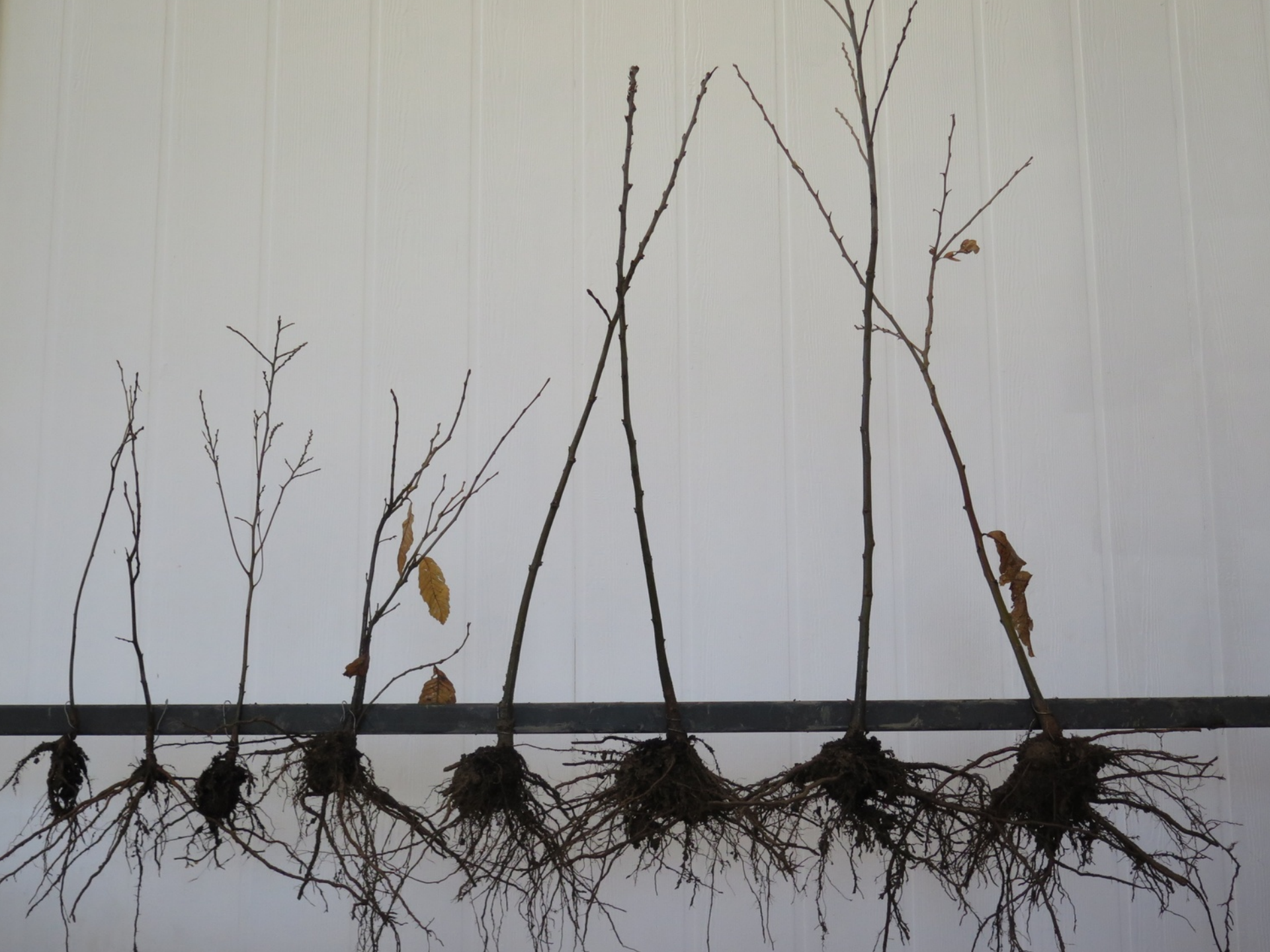
  Let’s consider ‘SZEGO’

Szego - Crenata/Pumila x Mollisima

Szego is a very complex hybrid, a seedling of the California hybrid Linden, which is predominantly Crenata/Pumila. The pollen parent of Szego may be the hybrid Dunstan Revival. Szego is a very vigorous and erect tree. It grafts well on almost anything. It is a heavy pollen producer. Nuts are uniformly large (12-16 per lb), but easy peeling and fairly dense, like most Chinese nuts. Nuts are sweet and flavorful, one of our best eating chestnuts. The nuts drop mid season (2-3 weeks after Colossal) and store very well. The tree is resistant to phytopthora root rot. Its blight resistance is not known but it has been growing for more than seven years in blighted areas without signs of blight. The tree is named after New York NNGA member Al Szego, who worked with many types of hybrid chestnuts before passing away in 1991. Mr. Szego was known for his generosity in providing others with nuts, scion wood and advice.

Also, very cold-hardy, more so than many Chinese.





Jenny - Castanea mollisima

Jenny is an open pollinated seedling of the old Ohio cultivar Kintzel. Like Kintzel, Jenny is a tall tree with a very erect growth pattern. It does not have an orchard type growth pattern like many Chinese chestnut trees. The nuts are large and very flavorful - one of our favorite eating buts. Despite their size, the nuts drop early in the season. Additionally, all nuts drop within a very short period of time once the first nuts start dropping.

Jenny - C. mollisima - 82 grams (16.6 per lb)

Combining Forces

- Wouldn't it be interesting to put 'Szego' and 'Jenny' pollen onto the male sterile trees, 'Luvall's Monster' and 'Ace'? We'll be harvesting with a front-end loader.

- In the meantime, hundreds of open-pollinated seedlings of the above cultivars, plus many more have been and will be planted in commercial orchards.

Kernel decay

- Fungal decay of chestnut kernels is one of the biggest problems we face.

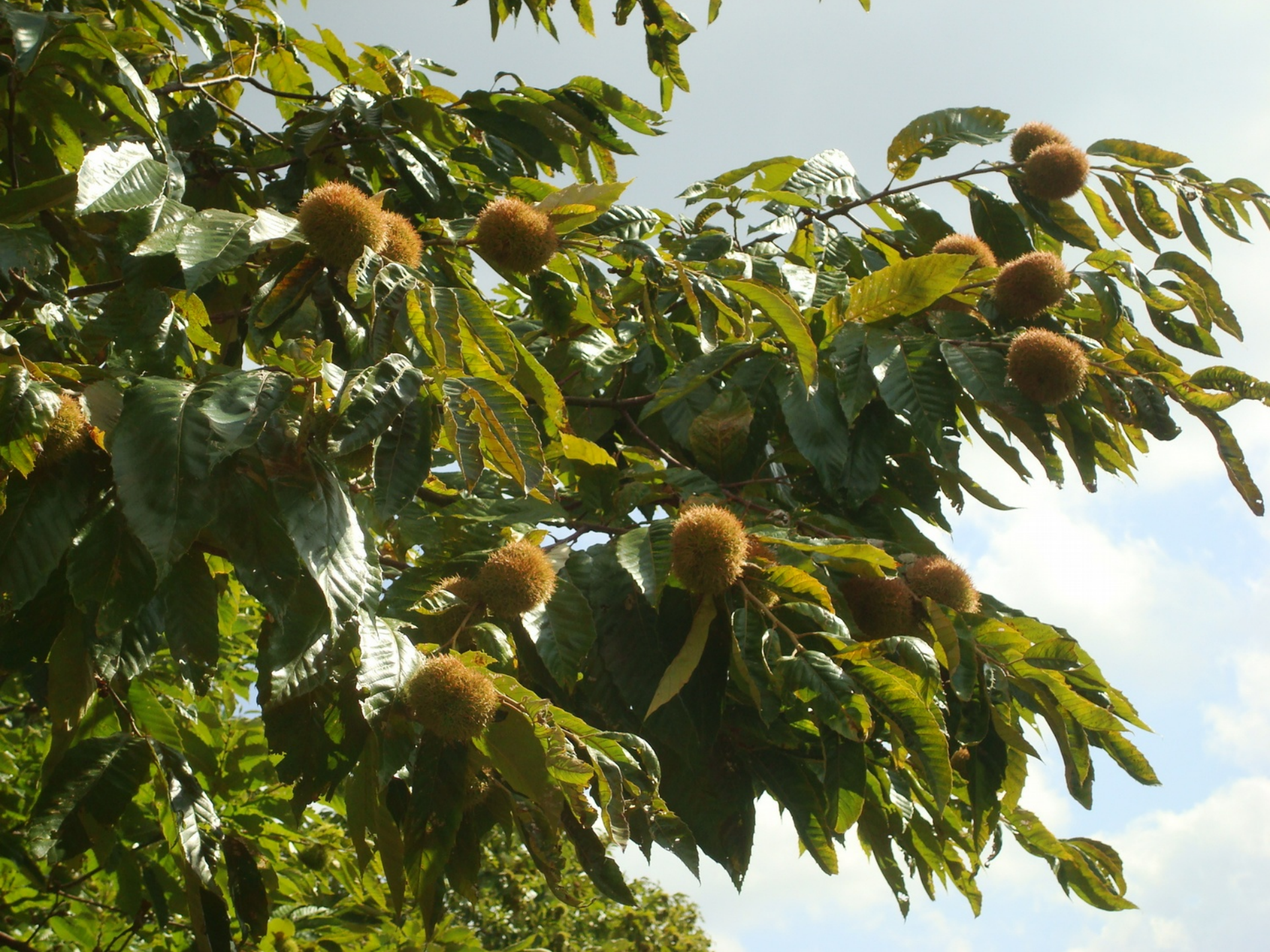
- In general, Chinese chestnuts hold up relatively well in storage (better than most European and Japanese chestnuts). Nevertheless, there is considerable genetic variation in storage quality.

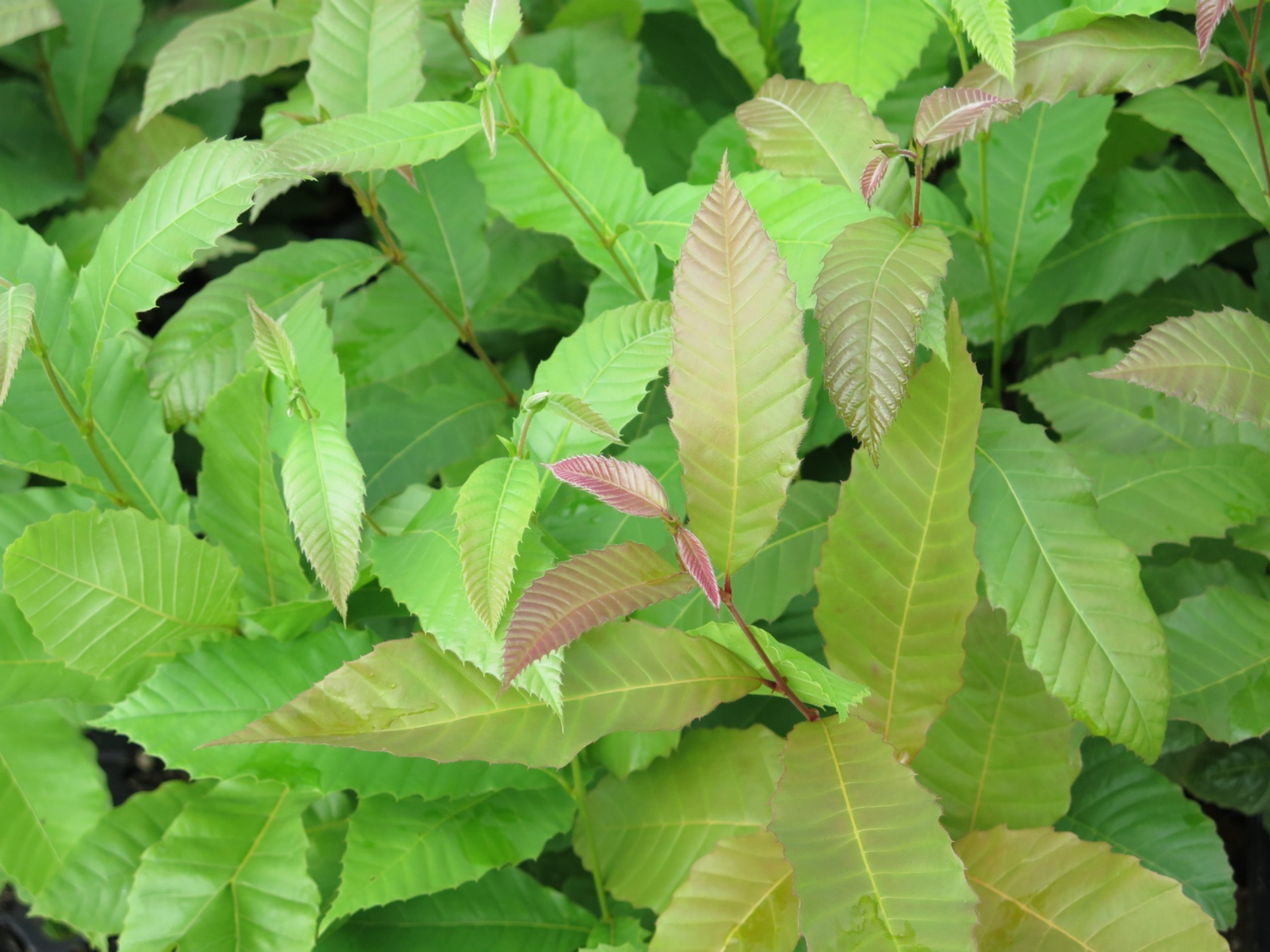
- Presumably, there are chemical and physical components that can be measured and selected for, but it hasn't been done yet.

Current Status

After storing dozens of cultivar nuts for seed we discovered one outstanding cultivar that had near zero blossom end rot and near zero storage rots for 2 years running: Namely **‘Liu’**.

Another good one, after 1 year’s look, is ‘WC’





Putting Ideas Into Action

- Univ of MO has collected and evaluated cultivars. The pollen cloud that lands on good cultivars comes from a diverse array of other good cultivars. This is some of the best chestnut seed available in the country.

- Empire Chestnut is turning this good seed into trees and distributing them to growers. These plantings can serve as seedling trials, progeny tests, and production orchards. Growers are planting trees at distances that allow future culling without diminishing land coverage.

- Ultimately, the process is funded by selling chestnuts

Participating Growers

Bob Stehli	OH	2540
Caney Fork Farms	TN	1000
Michael Schwerin	IL	595
Hill Craddock	TN	500
Matt Eusner	KY	400
Brian Stoffer	OH	360
Zach Petersen	NC	217
Jorge Rodriguez	NY	210
Henry Fuller	WI	200
Ismet Basic	IL	200
Randy Morgan	OH	200
Kevin Wolz	IL	150
Jonathan Carr	MA	100
Dominick Damiano	IA	50
Richard Mitchell	PA	40
		6762

Numbers of Trees Planted per Family

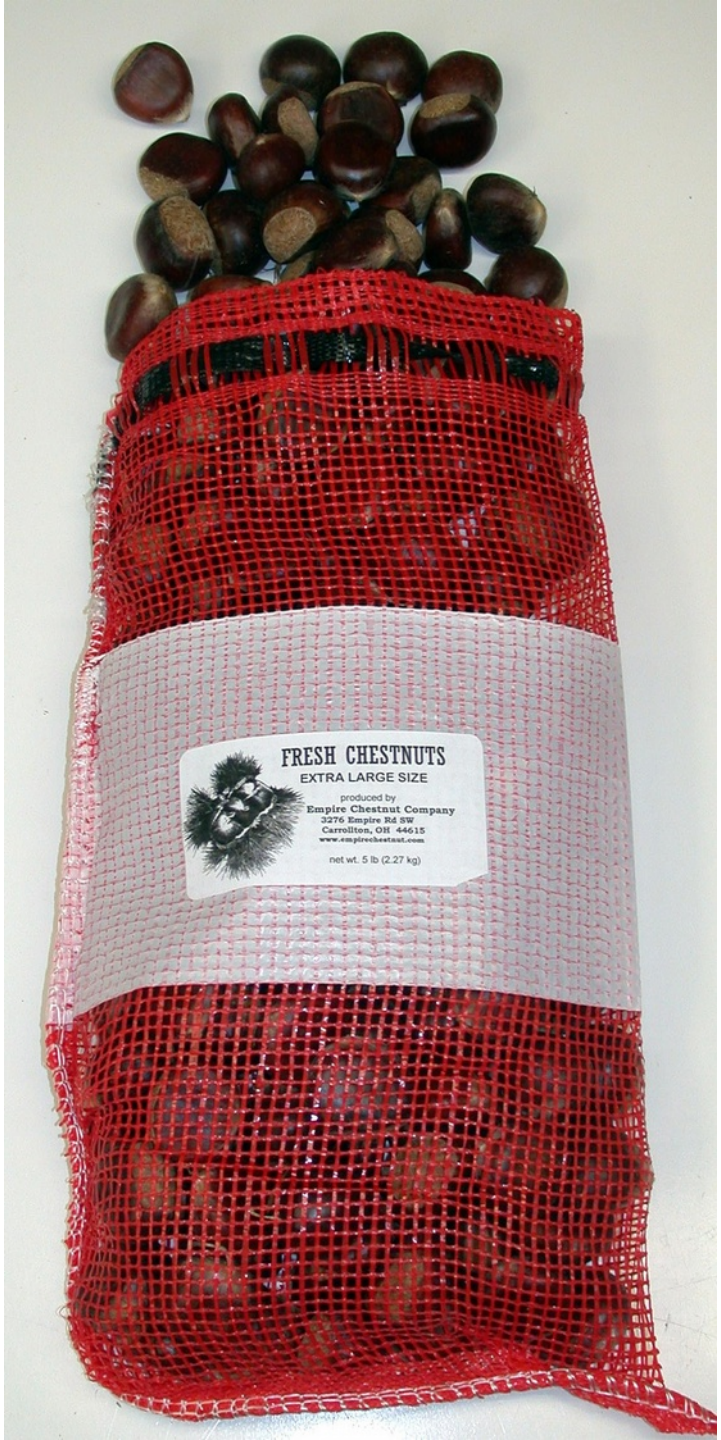
Gideon	760	B65	280
Szego	557	B71	270
Luvall's Monster	530	**Ace**	205
Kohr	520	**Perry**	120
Qing	470	**Payne**	120
Sleeping Giant	430	**Yixian**	120
Jenny	420	72-76	100
Liu (B66)	420	Jersey Gem	90
Peach	410	Dunstan	20
AU-Homestead	310	Wynn Miller	10
PQK	300	**Hong Kong**	10
AU-Super	280	Chandler	10
TOTAL		**6,762**	

Next Steps

- Controlled pollinations between selected parents. Hopefully, the cicadas will allow me to do it this year.

- Institutionalization of the program. It could continue as the spontaneous process that it has up to this point, but it will soon need to have someone in charge.

- Exploiting DNA sequencing techniques will be essential to sort out the confusion we have and guide us to where we want to be.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