SOYBEAN

Grower's Guide

SECOND GENERATION SEEDS

IN THIS GUIDE:

ABOUT US

Second Generation Seeds is a collective of
Asian American growers devoted to helping communities
of the Asian diaspora discover and deepen their cultural heritage through seeds.
Together, we are reclaiming the narrative around Asian crops and our foodways.

Written by Kristyn Leach
Illustrations by Emily Yao
Design by Ariana de Leña

www.secondgenerationseeds.com

CULTURAL CONTEXT & HISTORY

Let's just go ahead and get the bad news out of the way first. Soybeans, in their modern biotech iteration, are villains in our global food system.

They are one of the top three drivers of deforestation globally (along with beef and palm oil), poster children for genetically modified organisms and the corresponding chemical agriculture that has been exported to all corners of the world, and their role in the economy has displaced countless indigenous land stewards, impacting regional local food systems in favor of export platforms profiting the Global North.

While the United Nations' Food and Agriculture Organization (FAO) predicts that soy production will continue to increase dramatically, from around 276 million metric tons in 2013 to 390 million metric tons by 2050, only about 6% of this is consumed directly as food. The majority (70-75%) is used as feed for pigs, chickens, cattle and farmed fish, while the rest is used for vegetable oil or biofuel. Even when it's been embraced by the west, it gets seen as bland hippie food.

So yes, soybeans are embroiled in various catastrophic messes, and we should certainly be wary of the many nefarious agendas they are an apparatus of. But I also cannot bear the misinformation, and the blanket vilifying of plants who are in fact incredibly special, and potently good and valuable members of many farming systems. Allow me to make a case for the humble soybean. We should hate the game, not the player.

There are multiple hypotheses about the origin of soybeans, as well as their domestication processes. The area around the Yellow River in the Huanghe region of China contains the largest abundance of charred archaeological specimens of Glycine soja, the wild progenitor of the soybeans we know today, Glycine max. The area around the Yangtze River basin is also proposed as the birthplace of soy based on phylogenetic analyses that claim the region to hold the most genetic diversity within soy, including plants belonging to Glycine gracilis, which is believed to be a bridge and transitional species between G. soja and G. max. It's believed that G. max diverged from G. soja over a span of time between .27-.8 MA.

Upon examining the chloroplast genome of wild, landrace and improved soybeans, there emerged an idea that there were multiple simultaneous domestication events throughout East Asia, because multiple maternal lines are present in various strains of soy lineages. Korean and Japanese soybeans possess very different gene pools in their chloroplast and nuclear genomes, supporting the idea that soy domestication happened in distinct processes in these various locales. Korea has the oldest archaeological remains containing a cultigen sized soybean who resembles domesticated forms, and Korea and Japan show early advances in selecting for bean size. It's clear that there were multiple selection pressures including: pod shattering, seed hardness, plant stature/bushiness (G. soja is predominantly vining), photoperiodism, as well as flower, pod and seed coat color and pattern.

By the 13th century soy had made its way via merchants and traders from Southern China to Java where in modern Indonesian it's known as kedelai. By the 1600's the Dutch East India Company had brought them to India. Knowledge of soybeans gets introduced to the Iberian peninsula courtesy of Jesuit priests who had travelled to Nagasaki, Japan in the early 1600's as well, though it wouldn't be until the late 1800's when the Portugese would try to cultivate them.

In the late 1700's soybeans arrive in North America by an East India Company sailor who brought them from China. Small amounts were cultivated to make soy sauce to send to England, while the majority was utilized for forage. By the late 1920's soybeans were seen as a promising field crop in the United States because of their forage potential, as well as their protein content and nitrogen fixing capabilities.

Speculation on the value of soy led the USDA to fund a significant plant "finding" expedition led by William Morse and Palemon Dorsett in 1928. Their team spent two years traveling through China, Manchuria, Japan and Korea collecting seeds and information on the culinary applications of soybeans, as well as persimmons, adzuki and mung beans.

Prior to this, the USDA had funded four other expeditions to China and Manchuria in search of soy genetics between 1905 and 1918. Dorsett had also previously travelled to northeast China and Manchuria from 1924-27, sending over 1,500 seed samples back to the U.S. where they were used in early breeding programs. The Dorsett-Morse expedition (1928-30) provided the U.S. with the most substantial base of information and germplasm.

It's worth noting that while much of their expedition and collection was from trespassing in farmers' fields, and taking beans from marketplaces, Dorsett and Morse also worked with agricultural experiment stations and agents. These stations and researchers were predominantly Japanese, working in colonized territories (Manchuria, Korea and Taiwan), and so the perspectives shared were overwhelmingly representative of imperial Japan.

Japan was breeding improved varieties, attempting to displace regional landraces in order to export food from their territories back to Japan. Dorsett and Morse in fact note in their journals that many of the peasants they encountered across East Asia loyally persisted in growing the varieties passed on to them by their "honorable ancestors" and had little interest in growing newer varieties developed by researchers.

We can observe in their writing a perspective that doesn't acknowledge the role that peasants played in cultivating diversity within soy, and the more esteemed legitimacy being placed on perceived elite high yielding varieties designed to be grown more broadly and with less regard for specific climates, cultural, and culinary preferences. We also see how their expedition, and the growing collection of soybean genetics empowers the U.S. to broker various trade deals.

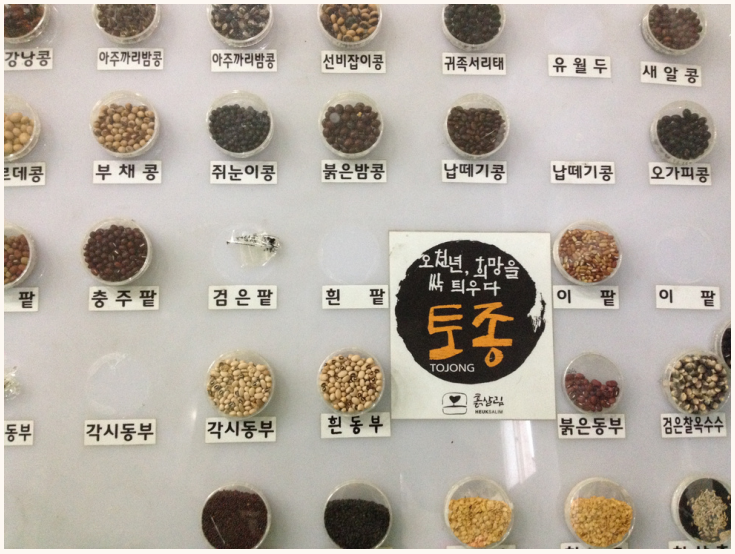
In 1930, the U.S. imposed heavy import duties on soybean oil and meal from Manchuria, and began negotiations with Europe to export soy products there, affecting Manchuria's trade with the west. Dorsett and Morse are credited with being soy's greatest champions having collected 4,578 distinct soybean samples (73.8% came from Korea, 12.6% from Japan, 11.2% from Manchuria, and 2.4% from China), with 150 of these varieties being large-seeded vegetable types from Korea and Japan.

It's approximated that 85% of the soybean genetics of North American breeding pools are derived from as few as 19 landraces.

These types of plant expeditions show us how botany becomes enmeshed and in service of empire building. While it is worth questioning the dubious nature of how so many crops were taken from all corners of the globe - many times to have portions of their genetics patented - the Dorsett-Morse journals at least tried to capture soybean as human food and the myriad ways that it served as a cornerstone of East Asian food culture.

Many of the accessions they brought to this land are stored in the USDA Germplasm Resources Information Network (GRIN) database; their true names traded for plant identification numbers, culinary and agronomic traits distilled down to crude protein content. Morse never got to see much progress in his attempts to shift perception of soy as human food. Soybean production and processing exploded in the following decades, as seeds from this journey to East Asia were sent to breeders at the USDA and plant experiment stations in the Mississippi and Ohio Valleys.

In the few weeks I spent in Korea in 2014, I was fortunate to meet many of the landraces lovingly grown and preserved by peasants. I learned the various names people know them by, which ones grow best at various latitudes, how to process the seed on such a small scale, as well as how to sort beans for various uses. I watched as the halmoni I stayed with quickly assessed which beans were going to be saved for planting, which were for banchan, and which would be steamed with rice. I got to eat so many of the a mazing foods made with soy products. Homemade doenjang, dubu, and kongnamul, all with distinct variations based on region and household.



Native beans are a particular area of interest for the Korean Womens Peasants Association, who work with farmers to increase seed stocks, as well as increase awareness and excitement about the culinary uses of different cultivars.

Soybeans have also played a crucial role in building and sustaining soil fertility in agricultural systems across East Asia. They have the highest rate of biological nitrogen fixation of any field crop (450kgN/ha-1), providing a protein rich food source that benefits from a lack of synthetic fertility. Soy and adzuki were grown in rotation with other crops, and were also used in intercropping schemes, fostering fertility for companion crops.

Wild and semi-wild landraces were also grown at field edges as famine foods, reliably producing in unpredictable seasons. On our farm, soybeans are grown in a rotation that creates a 4 year relay and nutrient cycling that eliminates the need for any additional inputs.

BOTANICAL OVERVIEW

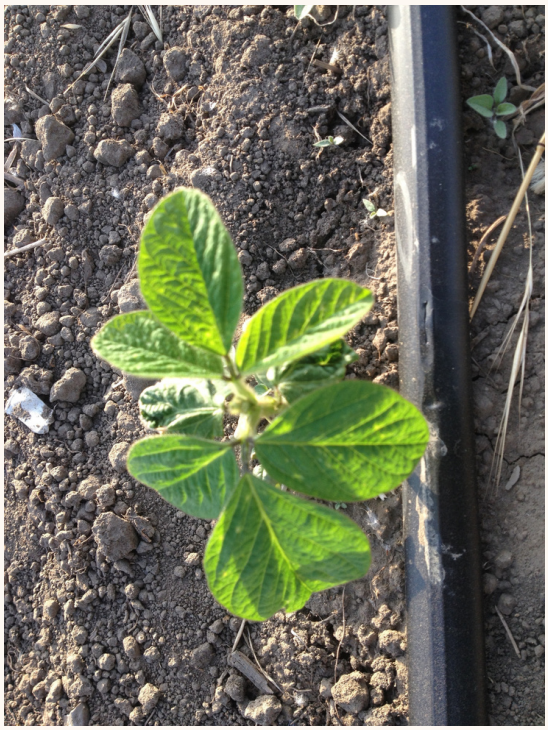
Soybeans are a warm season annual crop, with varying critical photoperiods. They are generally short day plants, flowering and maturing beans once the days start to shorten in late summer. They prefer warm daytime temperatures, and cooler nighttime temperatures. In areas where it never really cools down at night, you may see more flowers abort and drop. It's also important that they are planted not only after your last frost date, but also after the soil has reasonably warmed. Cool wet conditions can stunt young plants, or set the stage for pathogens.

Once they flower, they need reliable warm conditions to set good pods, and mature sturdy seeds. In northern latitudes you would need to find varieties that are suited for the short season and able to flower early enough for bean maturation.

For fresh eating pods (edamame), short early season varieties are preferred. These cultivars can set pods within about 70 days or so from emergence. They tend to be smaller in stature, growing less biomass before they begin flowering.

Beans preferred as dry beans, either to steam with rice or to prepare as a side dish, can be 90 days or more to maturity. On our farm our plants are generally cut to dry down in October, and threshed by November. Because of their incredible nitrogen fixing capabilities, they can be invaluable to crop rotations on the farm. Keep them on 3-4 year rotations to avoid building up any potential pest or disease pressure. When followed with a cover crop, many benefits can be relayed from soybeans to the following season's summer crop. Leafy greens can also effectively utilize nitrogen following soybeans in the fall, reducing or eliminating your need to supplement any additional fertility.

GETTING STARTED

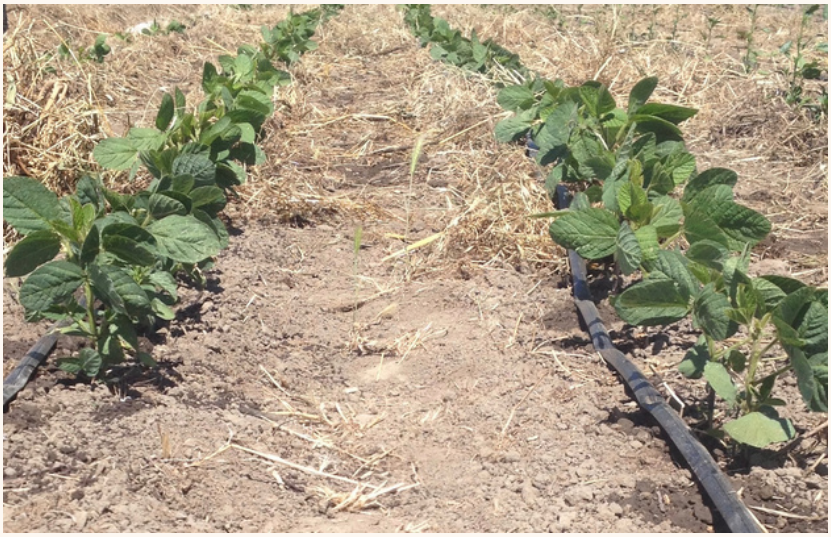


Direct seed once all danger of frost has passed. Pre-irrigate your planting area a few days ahead of planting (depending on your soil and its moisture holding capabilities). Plant seeds into moisture and hold off on irrigating until they germinate. If your soil is very sandy and drains quickly, you can irrigate in short sets each day or every other day, keeping the soil moist in order for seeds to sprout. Alternately, you can start seeds in a greenhouse 3 weeks ahead of your field planting date. Warm soil temperatures are as important as the ambient temperature outside! So don't rush too early in spring, especially if you had significant spring rains which will keep the soil cooler.

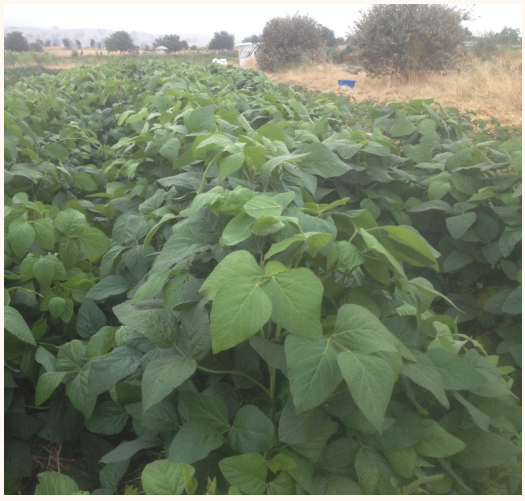
While cultivating beans in a greenhouse seems like an intense proposition given how much space they will take up, it can definitely help protect your crop from unpredictable weather in the spring time, and give plants an added boost in growing vigorously right out of the gate. We start seedlings in 128 cell flats, and transplant once they have their first trifoliate leaf. They will get leggy and stressed after this point, elongating their stems to access light. This can make transplanting a challenge as the stems can be unwieldy or delicate.

Despite all the challenges, transplanting slightly bigger seedlings is helpful in also mitigating pest predation. It turns out everyone loves soybeans, particularly rabbits and deer. Since both of these creatures forage at night as well as day, whole patches can be mowed down immediately after emergence. We've lost thousands of plants in a week due to jackrabbits. Now we fence our soybean area, and grow most of our crop as transplants, put in the field at the end of May.

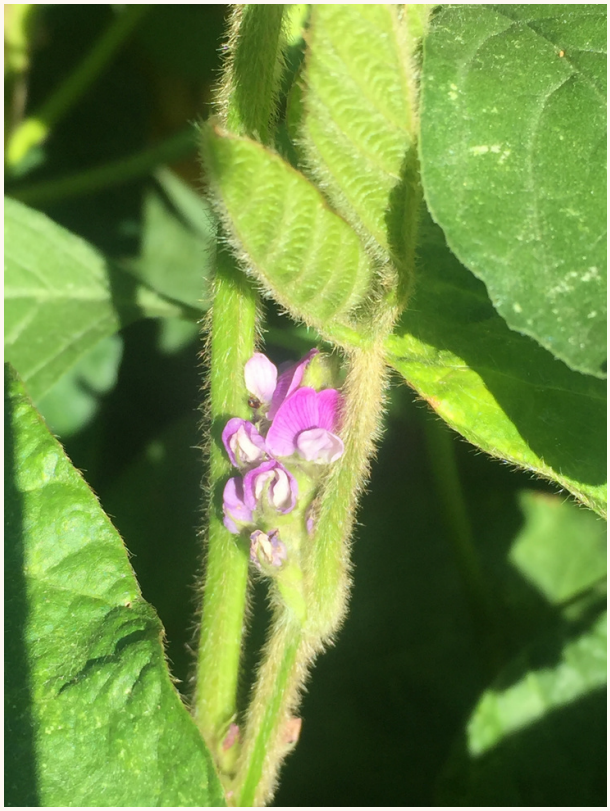
GROWTH



Once they come up and have a few leaf sets, plants are vigorous growers! While reasonably good soil structure is important for rapid root development, their nitrogen fixing capabilities mean you don't need to worry about fertility needs. In lean, sandy or rocky soils, you can amend with finished compost to improve soil organic matter, but other fertilizers and amendments are not needed, and can in fact work against the plant's innate abilities to scavenge and metabolize food for itself. Moisture is critical. Deep infrequent waterings are preferred once plants are established. Mulch is very beneficial in dry climates as it helps to retain moisture, and keeps the soil surface cool.

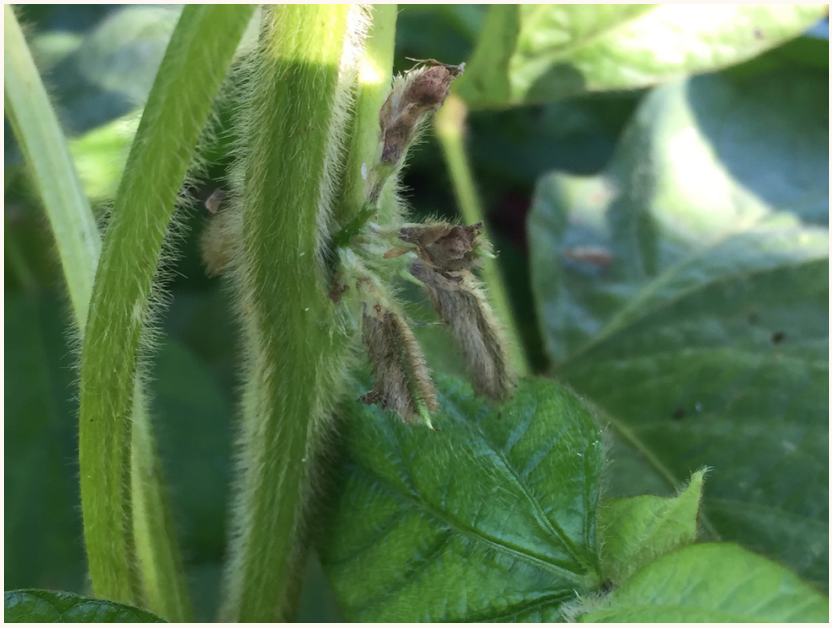


Soybeans, when they're happy, can be quite bushy. For short, early season varieties you can plant them at 8-10" spacing, but long season dry bean varieties benefit from 1' or more spacing on any side. Our farm plants soybeans in furrows which are minimally strip tilled, not raised beds. Soybeans can lodge (fall over) as they mature pods, and so raised beds can sometimes lack the support for growing plants. For the most part, even if plants fall over, as long as their roots remain in the soil, their shoots will amazingly re-orient themselves to find sunlight and air.



FLOWERING

In mid to late summer, flowering begins. Soybeans are heavily self-pollinating, in fact most flowers are pollinated before they even bloom. So there is very minimal crossing, though extreme heat can sometimes increase the likelihood of cross-pollination between varieties. From the beginning of flowering, it will take about 4-6 weeks for the pods to develop and come to maturity. Once the pods have plumped up, they will gradually change color from verdant green to brownish yellow, and their downy pubescence will also fade.

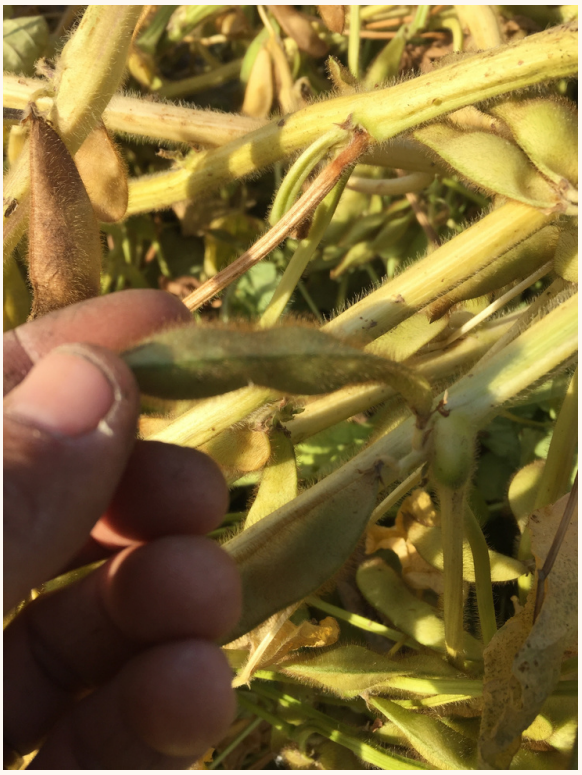


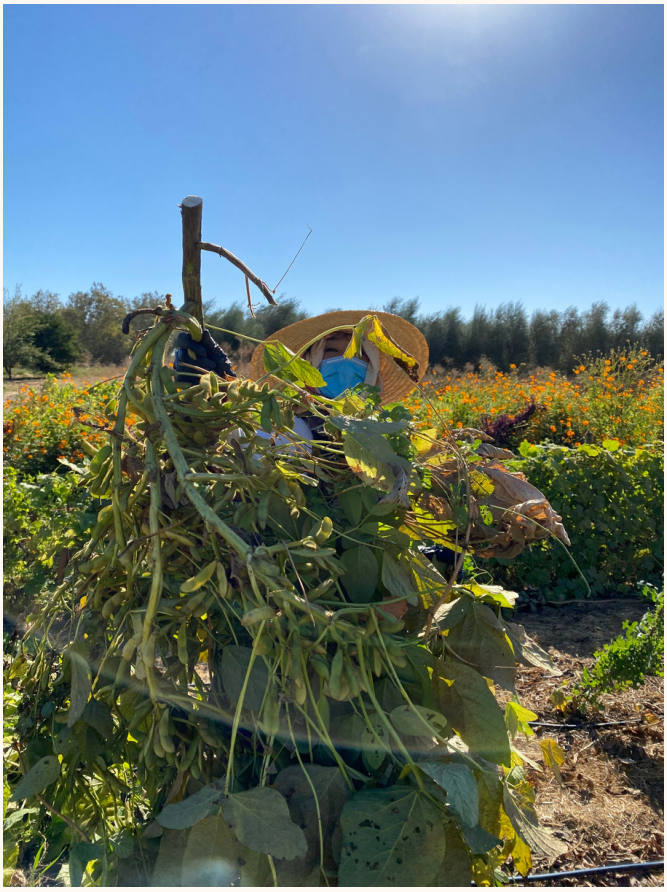
HARVESTING FRESH

If you're harvesting the fresh green pods, you can harvest individual pods once they are adequately plump, or cut whole plants. Soybeans are fairly determinant in their growth, and though pods mature at a slightly staggered pace, they mostly can be harvested in mass, at once for ease of harvest. The picking window is relatively short once pods have sized up since you want to harvest before they start to fade color. This indicates that their seed coat is forming, and that they are drying and hardening, making less desirable fresh beans. To have a continual supply of fresh pods, it would be best to plant multiple varieties, suited for different windows within the season. You could probably plant two or three close successions of early season varieties, followed by one or two successions of mid-season cultivars. For dry beans, you will most likely have one optimal window for planting in order to have enough days to mature the seed.

HARVESTING SEED

Once beans have hit their size, they will begin to dry down and form their seed coat. At this stage, you can cut the whole plants at the base and bring them out of the field to finish drying for dry bean and seed harvest. If left in the field, pods will tend to shatter as beans mature, reducing your harvest.

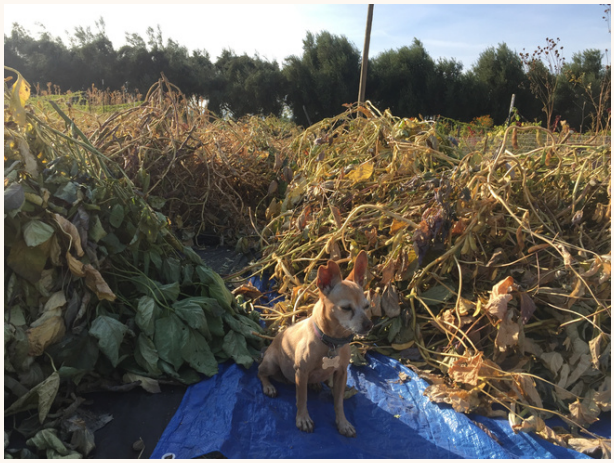


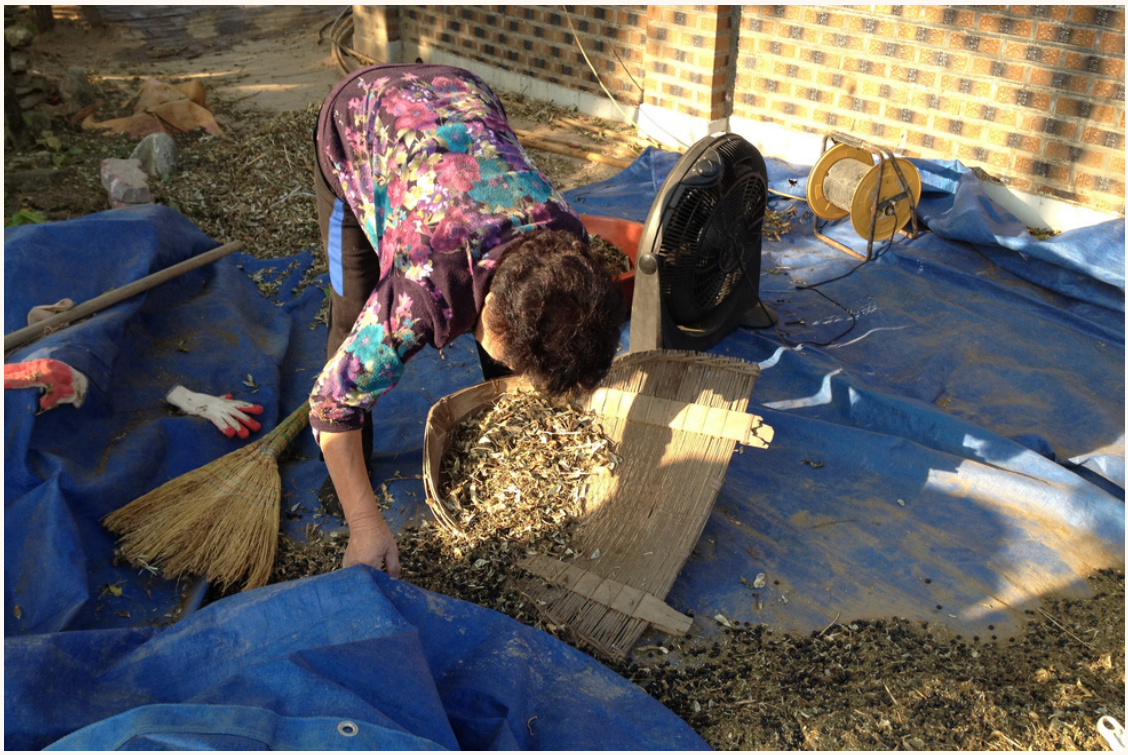


Place beans on a tarp and allow the pods to finish drying. You will be able to tell when they are ready because during the middle of the day you will hear pods breaking open with a lively pop. Once the majority of pods are dry enough that they break open with just a little pressure between your fingers, you can thresh them.

THRESHING

To thresh, lay plants out and give a solid whack with a flail or stick. Alternately have some friends over to stomp on the pods. Give plants a shake to hear if beans are left and then either pop individual pods open, or if still too moist, take pods off and dry on a tray. Proceed to winnow off chaff, either pouring beans between two buckets in front of a fan or on a windy day, or using a winnowing basket. Reserve plants to return to field afterwards.





SOYBEANS AT A GLANCE

SUN:
Full to partial sunlight

PLANTING DATE:
Plant after any threat of frost, once soil has warmed, end of May through mid-June

GERMINATION TEMPERATURE:
70F

PLANT SPACING:
8-12”

PLANTING DEPTH:
.5”

MOISTURE:
Moderate. Deep, infrequent waterings. Avoid oversaturation of soil.

DAYS TO MATURITY:
70-120+ days from emergence

SOURCES:

"Soybean Domestication: The Origin, Genetic Architecture and Molecular Bases" by Eric J. Sedivy, Faqiang Wu, Yoshie Hanzawa

Union of Concerned Scientists: https://www.ucsusa.org/resources/soybeans

"The Soybean" by Dr. Charles Vancouver Piper and William Morse