



Production and Economic Considerations for Fresh Market Edamame in Southwest Virginia

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Introduction

Vegetable soybean [*Glycine max* (L.) Merril] is a type of food-grade soybean originating from East Asia. Edamame, pronounced “eh-dah-mah-may,” is an immature soybean, harvested between growth stages R6 and R7 when pods are about 85%-90% filled and bright green. It is consumed by sucking the fleshy, immature beans, often bearing a smooth texture and sweet, nutty flavor, out of the pods. Most often served as a snack or appetizer, edamame is widely heralded for its potentially beneficial roles in cancer prevention, reduction of LDL (“bad”) cholesterol, and cardiovascular health (Magee 2005). It is also highly valued for its complete protein, containing all essential amino acids, and plant-promoting phytohormones called isoflavones that have been associated with cancer prevention (Thalheimer 2017). This myriad of health and nutritional benefits, as well as consumers’ widespread assessment of edamame as being tasty, versatile, and easy to prepare, has generated considerably increased domestic demand for the product since its introduction to U.S. markets nearly two decades ago.

Currently, edamame production in the U.S. is primarily dependent on the availability of nearby commercial processing facilities that buy edamame from growers, process it, and either export or distribute it to grocery stores where it is predominately sold as a frozen product available to consumers year-round. Unfortunately, with the edamame industry in the U.S. still in its infancy, an overall lack of these processing facilities around the country has largely limited production (Bennett 2016). This has forced the vast majority of domestic demand to be filled

via foreign imports (ACSESS n.d.; Roseboro 2012), highlighting the need to find ways to boost domestic production and allow U.S. growers to capitalize on edamame’s premium market position.

Some reports conclude that processing methods used by commercial processing facilities may reduce the nutritional quality of edamame (Simonne et al. 2000). Incidence of various foodborne pathogens such as *Listeria monocytogenes* in processing plant machinery has also been reported (Aguado, Vitas, and Garcia-Jalon 2004). Growers who produce edamame for the fresh market sidestep these issues and forego the need for nearby processing facilities, but fresh market edamame production is time-sensitive and labor-intensive. Growers interested in producing fresh market edamame require tools that can help them make more calculated and informed production decisions to maximize use of time and inputs, boosting profits.

As with any new crop, growers must first determine if edamame is feasible to produce by estimating its production costs and potential expected returns (Hofstrand and Holz-Clause 2009).

This study is the first to present production and economic considerations for fresh market edamame in the state of Virginia and can be useful to growers considering its production. To evaluate the economic costs of producing and marketing edamame in Virginia, fresh edamame was grown in research plots at the Kentland Farms and sold to local distributors in Blacksburg, Virginia. We estimated costs of production using information from research plots, including labor hours associated with harvesting and post-harvest

activities, as well as revenue from sales. Growers can use this information as a guideline to develop planting and crop rotation decisions. This will aid in assessing the economic cost of producing and marketing of these edamame products.

Production Considerations

Planting and Preharvest

Planting and preharvest of edamame closely parallel that of conventional grain soybean, with growers needing only to accommodate for edamame's larger seed size (Zeipina, Alsina, and Lepse 2017). It is common for direct-seeded edamame to experience poor seed emergence and stand count (Miles 2002; Sanchez, Kelley, and Butler 2005). Edamame seedlings can be grown in greenhouses and transplanted for improved stand count. However, this method is not economically feasible for large-scale production (Sanchez, Kelley, and Butler 2005). Additionally, recommended planting depth for edamame seeds is no greater than one-half inch deep to avoid reduced emergence (Miles et al. 2018). Only a handful of approved post-emergence herbicides can be used on edamame, leaving most of the weeding to be done by hand or spot spraying during early season growth. However, once edamame plants develop canopy cover, most weeds should be shaded out, reducing the need for weeding.

Harvest

Once edamame pods are 80%-90% full and bright green, growers have only a few days to harvest, process, and sell edamame before pods become yellow and unmarketable. Given this relatively narrow harvest window, growers must be sure to closely monitor edamame as pods begin to fill and be ready to harvest as soon as possible once they are ripe. Since the pods are immature, they are not dry enough to be harvested by traditional soybean harvesters. In small operations, fresh edamame is hand harvested, by which plants in the field are cut at the base of the stalk using a knife, scythe, or garden clippers (Shanmugasundaram 1991). Commercial bean pickers or green bean pickers can be used for harvest, but bruising can occur, last estimated to be about 24% and 5%, respectively (Born 2006). In addition, growers must note that commercial bean pickers automatically separate pods from stalks, preventing them from supplying on-the-stalk pods to

consumers. This may be more significant in markets where on-the-stalk edamame pods are preferred, such as Japanese markets (Born 2006).

Post-harvest Handling

Once edamame plants are harvested, they must be processed into one of three end products: edible bouquets, stripped pods, and shelled beans (which are also referred to as mukimame).

Making edible bouquets of pods on the stalk involves first trimming harvested plants down to individual segments. To make bouquets more aesthetic, marketable, and conveniently sized, all segments should be similarly sized, trimmed to no more than a foot, with excess leaves and regions of stalk cut off. It is acceptable for segments to be branched if they are still relatively narrow. Once plants are trimmed, a scale is needed to determine how many segments will make up a bouquet. In our study, bouquets consisted of roughly 650 grams (about 1.5 pounds) of segments. Once bouquets are weighed, they should be held together tightly with a rubber band or string.

To make stripped pods, remove pods from harvested plants. This is typically done by hand.

Making shelled beans requires an additional step of separating edamame beans from the pods. Edamame beans are removed mechanically or by hand. Shelling edamame by hand involves gently opening pods so that beans are removed without damage. Shelling by hand often fails to exclude the pericarp (inner skin of the pod), which produces an undesirable flavor (Miles et al. 2018). Shelling edamame pods is also a very labor-intensive and time-consuming process if not done mechanically, so if growers wish to supply this particular end-product to their local market, they should strongly consider looking into shelling equipment..

Storage

It is important to keep edamame cool throughout harvest and processing to preserve taste, freshness, and quality (Zeipina, Alsina, and Lepse 2017). Therefore, growers need to have a cooler or freezer on hand to store edamame. Edamame should remain refrigerated during or after processing or immediately following harvest if processing is not done right away. Edamame stored at proper conditions, 32 degrees F and 95%

humidity, can retain flavor and appearance for up to two weeks (Chiba 1991). Edamame can be refrigerated for up to three days following harvest before the beans begin to degrade and become unmarketable (Miles et al. 2018).

Economic Considerations

Labor Costs

One of the biggest costs for fresh market edamame production are harvest and post-harvest labor (Born 2006). Small-scale growers must find innovative ways to cut labor costs and maximize profit. For example, in our study we experimented with using a simple gas mower to cut soybean plants at the base of the stalk and compared results to those of traditional hand harvest using garden cutters. The gas mower reduced harvest time by over 100 hours per acre without significantly affecting yields. If labor cost is assumed to be \$11.46 per hour, based on the 2018 Virginia Adverse Effect Wage Rate (Employment and Training Administration 2017), using a mower can save a grower over \$1,100 per acre in labor costs. We also used a wooden pod stripper, consisting of a carved wedge mounted perpendicular to a flat wooden board (figure 1) through which branches of soybean plants can be pulled to separate pods more quickly than picking them off individually by hand. This pod stripper appeared to be more useful in de-podding indeterminate varieties which are taller and less branched, allowing whole plants to be pulled through the pod stripper without the need for additional trimming of branches beforehand.



Figure 1: Wooden pod stripper used at Virginia Tech's Kentland Farm for edamame pod separation.

Harvest Window and Variety Selection

A major factor affecting fresh market edamame production is its relatively narrow harvest window, during which growers only have a few days to harvest, process, and sell edamame before it turns yellow and unmarketable (Born et al. 2006; Nolen et al. 2016; Miles et al. 2018). Staggering planting by maturity group can potentially circumvent this issue and extend harvest windows (Nolen et al. 2016). By staggering planting by maturity group, growers can manipulate their edamame crop to ripen one portion at a time in a successive, continuous fashion, making harvest more manageable. The production system can also play a role in length of harvest window. For example, in Virginia it has been shown that an edamame crop consisting of Maturity group III, IV, V, and VI varieties planted simultaneously in a conventional production system can result in a supply window of approximately three to four weeks, while the same crop planted on plastic-covered seed beds can last approximately five to six weeks (Nolen et al., 2016). Planting time did not appear to have a significant effect on yield in this study, however growers may wish to plant earlier to access early season markets in July. Nevertheless, staggered planting by maturity group can ultimately help decrease labor costs, prevent loss of product, and increase the overall profitability of edamame production.

Seed Inputs

Commercial edamame seed is relatively expensive (Miles n.d.; Sanchez, Kelley and Butler 2005). It is estimated that these seeds can sell for anywhere between \$18-\$45 per pound, or roughly \$1,800-\$6,750 per acre (Miles, n.d.). A slightly lower yielding but considerably more affordable option for growers is to purchase large-seeded food-grade soybean seeds. As most recently reported, the cost of large-seeded food-grade soybean ranges from \$46.85 to \$59.90 per acre, with the average cost around \$53.87 (Mayta et al. 2014). In our experiment, we used experimental edamame lines developed from our breeding program's large-seeded food-grade soybean germplasm instead of commercial varieties and experienced no added difficulty marketing it. Large-seeded, food-grade seed may be even more successful in areas where consumers are not as particular about their edamame.

Conclusion

Overall, edamame is a potentially profitable crop for farmers in Southwest Virginia. However, edamame production will continue to be limited to those with appropriate equipment (modified green bean harvester). Future research will focus on collecting more detailed sales and production cost, since this information is limited due to this being a new crop in Virginia. Other research will also determine which end product is most desired by consumers, which will help producers enhance profitability.

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