Trialing edamame varieties and mulching in Richmond, B.C.

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Abstract

Edamame is a form of soybean (*Glycine max*) that has grown in popularity in recent years. This study evaluated the performance of four different cultivars ("Chiba Green", "Envy", "Midori Giant", and "Tohya") in small-scale organic production in Richmond, B.C. to made recommendations to local growers. Additionally, the application of compost as a mulch as a weed management strategy was also evaluated. This study examined germination rate, yield, weed pressure in time spent weeding, and palatability of the different varieties. Results show that there were no significant differences in germination, yield, or tasting scores between varieties. Mulch had a significant positive effect on germination and yield, but not on time spent weeding. Overall, compost mulch was found to be beneficial to edamame production, but there is a need to do further research on cost-effectiveness of growing edamame in small-scale and/or organic production.

Keywords

Edamame soybean, mulch, variety trial, weed management

Introduction

Edamame (*Glycine max*), also known as vegetable soybean, are soybeans that are harvested before maturity (R6 stage: full size green seed), and are consumed as a fresh vegetable (Konovsky et al. 1994, Xu et al. 2016). The beans are eaten as a snack or as an addition to soup, salad, and stir-fried dishes, and native to eastern Asia. Edamame varieties differ from grain-type soybean due to different desired characteristics, which includes taste, texture, and appearance (Fogelberg and Mårtensson 2021). Shifting climates and breeding for expanded range has presented growers with an opportunity to partake in a growing international market (Carneiro et

al. 2020, Zeipiņa et al. 2022). Several varieties of edamame have been developed in North America, which have also shown to be feasible for production in northern European climates (Fogelberg and Mårtensson 2021, Zeipiņa et al. 2022). Much of the literature has variety trails located in the southern United States. However, neither of these regions are analogous to temperate conditions of southern British Columbia, hence the need to provide background for local producers that are interested in expanding their market niche potential.

Weed management is one of the largest challenges of edamame production in both conventional and organic systems, but as is the nature of organic production, treatment is mostly limited to mechanical control (Crawford et al. 2018). Mulching is a common practice used in crop management for weed control. Using compost as mulch has an added benefit of adding nutrients to the soil and can increase soil temperature. Mulching edamame plants may improve plant success and reduce labour costs in small scale production.

The goal of this study is to determine what readily available edamame cultivars are appropriate for organic production in the Lower Mainland region of British Columbia. This is determined by germination rates and fresh weight yield; difference in yield between mulched and unmulched plots will are also evaluated. Time spent weeding in mulched and unmulched plots was used to compare weed pressure. A taste test session was conducted with students to gauge consumer palatability of the different varieties.

Methods

The central hypothesis of this study is that there will be a difference in production and consumer palatability between varieties, and that there will be a difference between mulched and unmulched plots in terms of weed pressure.

This study was conducted at the Kwantlen Polytechnic University Farm on the Garden City Lands in Richmond, B.C. The soil is a clay loam that does not have good drainage, which is not ideal as soybean prefers drier condition.

Treatments

Variety selection was made based on literature and availability to the region. The four tested were: “Giant Midori” (True Leaf Market), “Envy” (Adaptive Seeds), “Chiba Green” (High Mowing Organics), and “Tohya” (West Coast Seeds). “Giant Midori” was found to be the most palatable variety in a consumer acceptability study (Carneiro et al. 2020). It also is reported to have high yields and does well in clay soils (Zhang and Kyei-Boahen 2007). Envy is an early producing variety and is ready for harvest several days before other varieties (Zhang and Kyei-Boahen 2007, Miles et al. 2018). Chiba Green is a readily available cultivar and showed good yields grown in Latvia (Zeipiņa et al. 2022). Tohya is said to be an early variety by the supplier.

The second factor of this study is mulch use; the goal of which is to evaluate the efficacy of compost mulch for weed management and support of crop growth, compared to bare soil. Weed management effectiveness was estimated based on time spent hand weeding. Compost mulch (Net Zero Waste, B.C.) was applied in a roughly 5 cm layer with a manure spreader attachment on a tractor shortly after tilling the experiment location.

Design

The study area was arranged into a randomized complete blocked factorial design with three replicates (Fig. 1). Three blocks were split randomly in two, containing one mulched plot and one unmulched. Embedded in each of these plots were four subplots containing the different varieties, in random order. The total experimental area for the study was 46.8 m^2 (31.2 m X 1.5

m). Each subplot was 1.3 m long, and the main plots 5,2 m long, with a width of 1.5 m to allow for four planting rows with 40 cm spacing. Each plot had 30 cm of buffer.

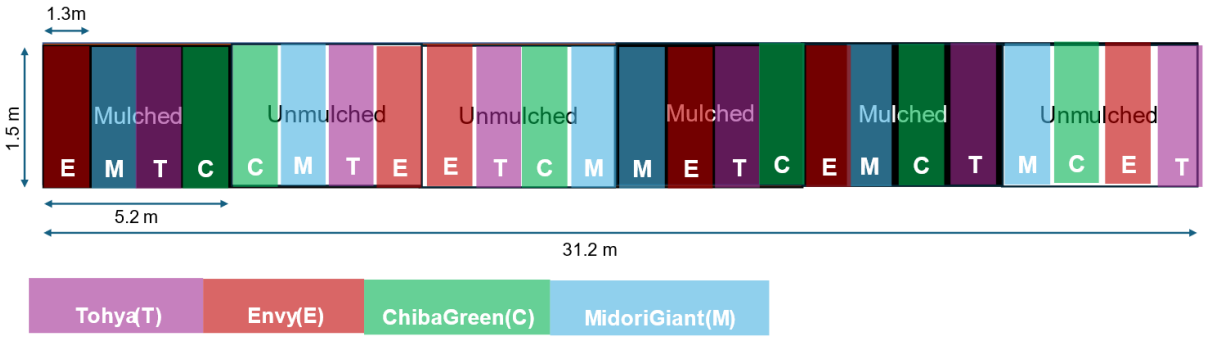

Figure 1. Plot map of study area.

Seeding was done by hand on June 5 and 6, 2024. Seeds were planted with 30 cm spacing within rows and at 7 cm depth, based on supplier recommendations. Inoculant was not applied due to lack of availability in small quantities from providers. Sixteen seeds were planted in each plot. Plots were initially irrigated with drip irrigation, but as the season was unusually wet and there were technical issues with the lines, the plots were left unirrigated in the latter half of the experiment. The study area was frequently monitored throughout this period and did not show signs of water stress. Weeding was done by hand with a diamond hoe and timed to estimate comparative weed pressure between the mulch treatments. Emergence was first noted on June 13, and the plots were protected with row cover to deter bird interference. The row cover was removed after a week.

One of the blocks was reseeded on July 4 because flooding in the plot led to very poor germination.

Harvest

Due to variable germination rates, all surviving plants were harvested and used for data collection. They initial plan was to harvest only from the central four plants to reduce edge effects. All plants, excluding the later replanted plot plants, were harvested on September 13, 2024, 14 weeks after planting. The replanted blocks were harvested two weeks later to account for difference in field time; however, the cooler and wetter weather in the latter part of the season limited the growth of these late plants as they were not nearly as productive as the other plots. Plants were harvested by cutting at the base and pods were removed from the plants once out of the field. All pods from plants in the same plot were pooled together then weighed (Ohaus CS 3000 scale).

Taste testing

Edamame samples underwent evaluation for consumer appeal. Edamame pods (100 grams) were washed, trimmed of ends, then added to 1 quart of boiling water and cooked for 4 minutes. After cooking, the water was drained, and the pods were cooled to room temperature. The beans were then stored overnight in a refrigerator before tasting the next day, before which they were brought back to room temperature. Testers were asked to score taste, texture, and pod feel of each variety on a Likert scale of 1-5 (unpleasant to very pleasant), as well as share any distinctive characteristics. The testers included students in the 2024 Agroecosystem Management class to a total of seven scorers.

Statistical analysis

All analyses were conducted in jamovi software. A mixed-model analysis was used for evaluating the variety treatment and mulch as fixed factors and replicate and plot as random effects. ANOVA was used to analyze for any interaction effects. To avoid pseudo-replication,

yield data are based on means of plots. Tasting scores were analyzed by ANOVA. Weeding time was evaluated using a paired samples t-test.

Results

Plant success

Yield was higher in mulched plots than in unmulched plots ($p<0.01$), but did not vary by variety (Fig. 2). Likewise, survival was not affected by variety but was affected by the presence of mulch ($p<0.01$) (Fig. 3). There was no significant interaction between variety and mulch. Significant block effects ($p<0.05$) were found for both germination and yield.

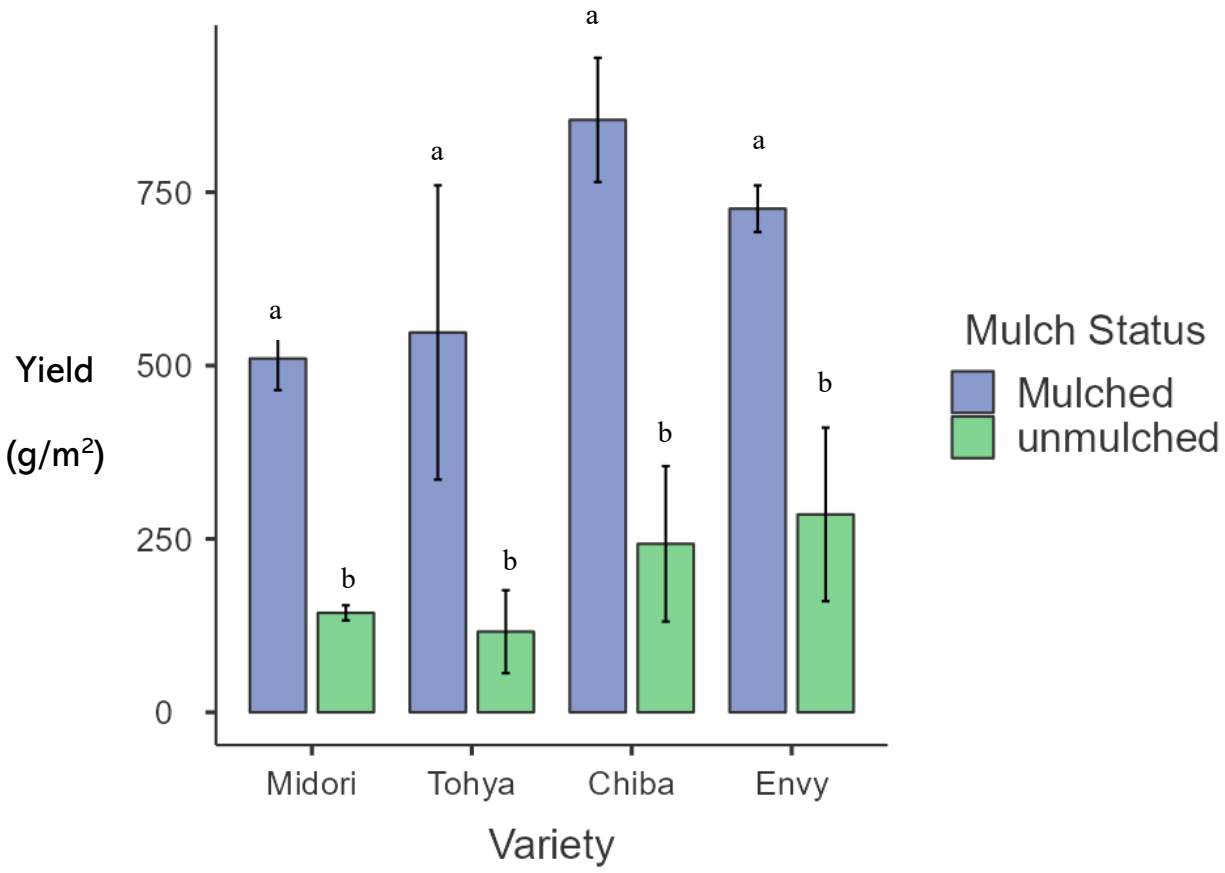

Figure 2. Edamame yield by variety and mulch treatment. Bars labelled with different letters differ significantly ($n = 3$, $\alpha = 0.05$). Error bars denote standard deviation.

Weed pressure

There was also no significant difference in weeding time between mulched and unmulched plots (Fig. 4). Only four measurements were made over the season, which reduces the reliability of this measure. Weeding was conducted every 7-10 days.

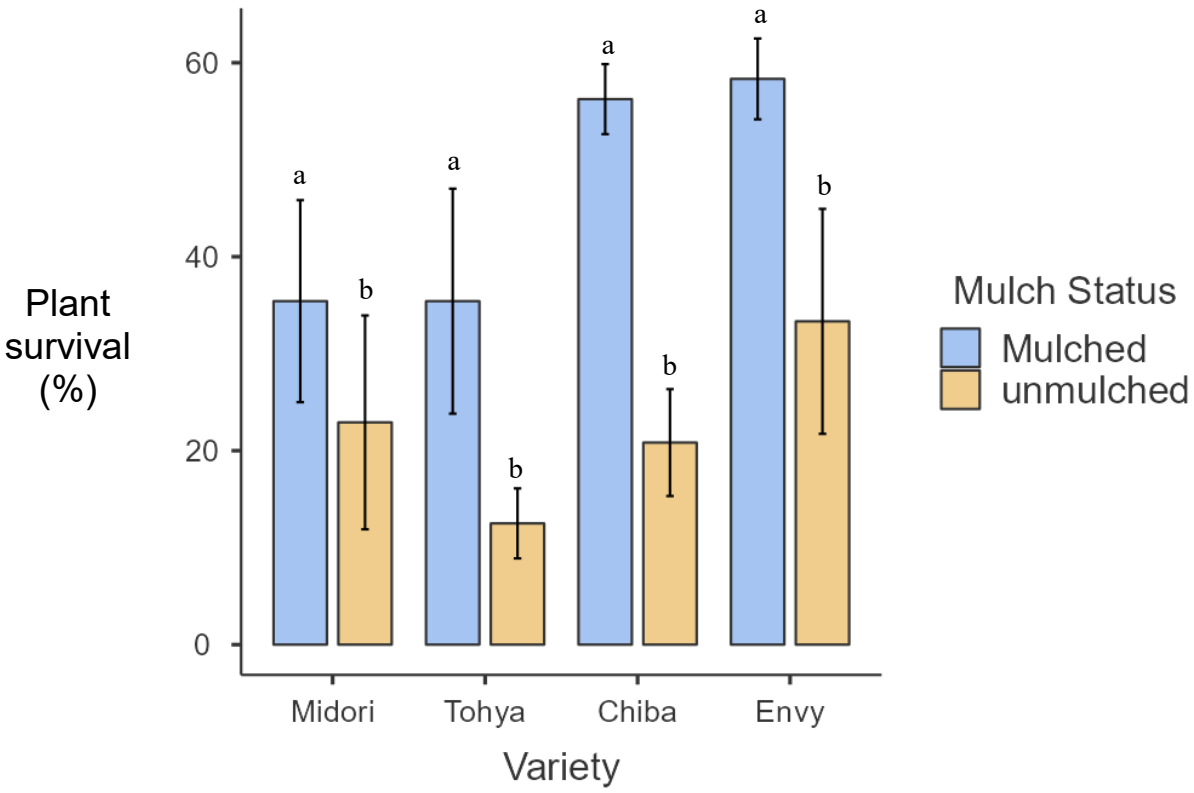

Figure 3. Edamame germination rate by variety and mulch treatment (16 seeds/subplot). Bars denoted with different letters differ significantly (n = 3, α = 0.05). Error bars denote standard error.

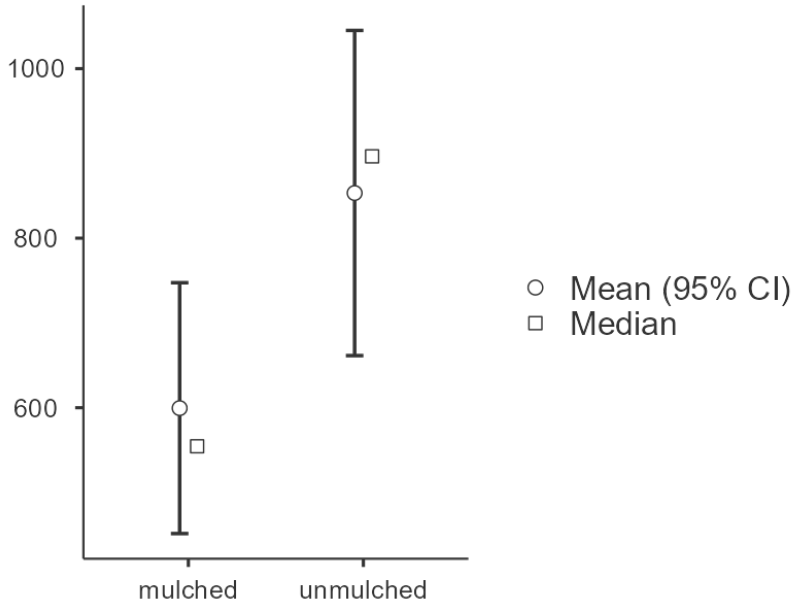

Figure 4. Time in seconds spent weeding by hand split by mulch treatment over entire study area. Difference not significant (p=0.19) Error bars denote 95% confidencee interval.

Palatability test

There were no significant effects of variety or scorer in taste, texture, and pod feel scores While some varieties were more polarizing, such as “Envy”, overall, all varieties scored well (means were above the neutral score of 3) (Fig. 5).

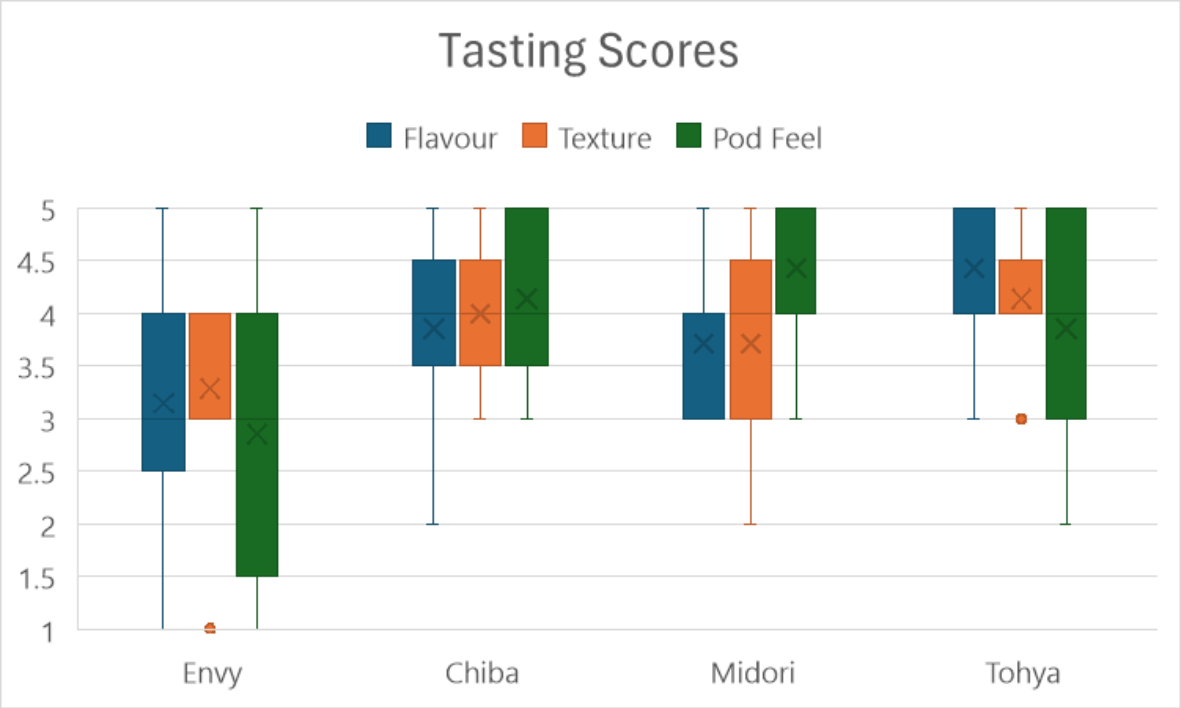

Figure 5. Distribution of scores for cooked edamame flavour, texture, and pod feel by variety. Error bars denote range of values, excluding outliers. Top and bottom of boxes represent 25th and 75th percentiles respectively (n = 7).

Discussion

Overall, both yield and survival of edamame soybean benefitted from mulch application. Weeding was much easier in the mulched plots as the looser tilth meant less effort to remove weed seedlings with the hoe. The plants in the mulched plots were generally larger than ones in bare soil and were more successful at shading out weeds. Further studies could examine effects of mulch quality (i.e.nutrition, colour, water holding capacity, and drainage) on edamame plant productivity.

Like most bean species, edamame prefers well-drained soil and hot weather. It is important to note that the site's soil is a clay loam, which is heavy and slow draining. As the mulched improved these characteristics, it is likely that the benefits of this application may be less pronounced in other soil types already appropriate for edamame. While the season for

vegetable type is shorter than oil soybeans, the decline in heat intensity in late August and September likely contributed to poor yield in the replanted plot.

During the tasting session, scorers had the most variable responses for Envy. Some tasters strongly disliked the dark hairs on the pods, while others found it the most interesting in terms of flavour. A few of the scorers noted that the seeds of the “Midori Giant” were quite small, this may be due to them not reaching maturity at the same time as the other varieties. In the future it would also be advantageous to record the weights of whole pods and seeds individually, since bean size is a factor that may influence consumer purchasing decisions.

It is important to note that although germination and survival was higher in the mulched plots, all plots had much lower rates than claimed by seed suppliers. It is unknown if this is due to bad seed or poor conditions, but it is drastic enough to bring in to question the actual cost effectiveness of incorporating edamame into a crop rotation. Also not considered in this study is the cost of using imported compost. A market analysis would be beneficial for growers interested in growing edamame to estimate the demand and costs of production.

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