

Edamame and Faba Bean Production: A New Look at Old Crops

Carol Miles, Horticulturist, Washington State University, Northwestern Washington Research and Extension Center Mount Vernon, <http://vegetables.wsu.edu>; and Jinguo Hu, USDA-ARS Western Regional Plant Introduction Station, Washington State University, Pullman, WA

Edamame

Soybean (*Glycine max*) is commonly grown in the U.S. for forage, feed, and oil. Edamame is a green vegetable soybean that originated in China more than 5000 years ago but is known today as a traditional Japanese vegetable. Edamame is harvested when the bean is fully formed and before the pod turns yellow, between R₆ (full seed) and R₇ (maturity) stages. Edamame is large-seeded, and is well suited to fresh consumption due to its sweeter flavor, smoother texture and better digestibility than field soybeans. Edamame was first grown and consumed in the US in the early 1930s and 1940s, when William Morse, known as the father of soybean in the U.S., worked with edamame at the USDA farm in Virginia and devoted himself to popularizing the crop. However, 8 decades later edamame still has not become an established crop in the U.S.

Soybean, including edamame, is photoperiod sensitive and is generally recognized as a short day, temperate crop. That is, plants will take longer to flower when they are grown in long-day environments. Also, cooler temperatures tend to lengthen the time to flowering. Our research has been done in western Washington, which has a maritime climate where the summer (May-Sept) is mild (48 °F average minimum, 72 °F average maximum) but relatively dry (1.6 in. rainfall per month). In contrast, summer temperatures in Syracuse are 57 °F average minimum and 76 °F average maximum with 3.6 in. rainfall per month (<http://www.usclimatedata.com/climate/united-states/us>).

Our field trials to screen edamame varieties suitable for western Washington began in 1995 with commercial varieties and breeding lines from the Asian Vegetable Research and Development Center (AVRDC), Taiwan. We evaluated commercial varieties and breeding lines. Field studies were carried out on-farm in Chehalis (1995-1999), at the WSU Vancouver Research and Extension Unit (2000-2006), and the WSU Mount Vernon Research and Extension Center (2007-present). Each year, the trial design was a randomized complete block with four replications. Plots were 2 rows wide and 10 feet long. Spacing between rows was 2-3 feet, and seeds were spaced 2 inches apart in the row. Plots were mechanically cultivated to control between-row weeds and hand weeded to control in-row weeds. Overhead (1995-1999) or drip (2000-present) irrigation was applied once a week as needed to provide 1-inch water per week until mid August, then irrigation was halted to facilitate pod maturity.

Number of days for emergence, first flower, and 50% flower were recorded, and plant stand and plant height were measured in each plot. Plants were harvested from the center 5 feet of each plot (total harvest area 10 feet per plot). Pods were handpicked, sorted into categories (2-3 beans-per-pod; 1 bean-per-pod; and unmarketable), and weighed. From the 2-3 beans-per-pod category, 100 pods were randomly selected and weighed, and of these, 25 pods were randomly selected, shelled, and the number of beans was counted. The weight of 25 beans was also measured.

Table 1 includes marketable yield (g/10-foot row) from 1995 to 2002, as well as an overall average for each variety and the overall mean for each year. Individual reports for each year can be found on our website, <http://vegetables.wsu.edu/edamhome.html>.

Faba Beans

Faba bean (*Vicia faba* L.) is one of the earliest domesticated crops, with remains found in archeological sites in north-west Syria dating to 10,000 BC. Large seeded types are from the Mediterranean basin, dating to 2000-3000 BC. Faba beans spread to North Africa and Europe, where they were the only bean crop until the 1500's when common bean (*Phaseolus vulgaris*) was imported from South America. Faba bean moved simultaneously to Peru and Bolivia where landraces were developed that have a wide range of seed variability.

Faba bean is a versatile crop and is used as food, feed, forage, vegetable and a cover crop. Faba bean is a dietary staple in China, the Middle East, and North Africa. Like other grain legumes, faba beans are a good source of protein (25-37%), vitamins, minerals and phenolics. Faba bean is different from other legumes in that it produces L-3,4-dihydroxy phenylalanine (L-DOPA), the major ingredient of several prescription drugs used to treat Parkinson's disease (PD), the second most common neurodegenerative disorder. L-DOPA content in young pods is 6–7%, and it has greater efficacy and is longer lasting than synthetic L-DOPA. Faba beans also contain tannins, which cause a bitter flavor and reduce protein digestibility, and vicine-convicine which may be responsible for favism, a rare disease characterized by acute hemolytic anemia. Breeding is underway to reduce these two negative traits.

Faba bean has the highest nitrogen fixing capacity of all grain legume crops, and can contribute up to 200 kg N/ha when used as a cover crop. Faba bean is grown by small and medium-scale farmers in the U.S., primarily for immigrant and ethnic consumers. The most commonly grown varieties in the U.S. are open-pollinated heirlooms. Faba beans tend to be susceptible to several diseases, including chocolate spot (*Botrytis fabae* Sard.), root rots (*Fusarium* spp.), rust (*Uromyces viciae-fabae* (Pers.) J. Schröt.), ascochyta blight (*Ascochyta fabae* Speg.), and downy mildew (*Peronospora viciae* Berk.).

In general, yield from fall-sown faba bean is greater than a spring-sown crop, however winter hardiness is a challenge in some areas. New breeding efforts are underway to improve winter-hardiness, with a focus on vegetable varieties. In Washington State, 14 entries (6 German, 4 French, and 4 Bulgarian) were tested at 2 sites for 3 years. One winter hardy entry 'Hiverna/2-5EP1' from Germany was identified and crossed with the non-winter hardy vegetable variety 'Extra Precoce Violetto.' Plants were multiplied and selected for 3 generations; 2 lines survived the winters and produced seeds, were advanced to the F5 generation, and were uniform for plant height, flowering time and seed size, however seed coat color was still segregating for purple and grey. Eight F6 lines were selected and planted in a replicated trial at 3 Washington locations (Pullman, Central Ferry and Mount Vernon) in 2012-13. In addition, seeds were distributed to requesters in eight states, Washington, Oregon, Montana, Iowa, North Carolina, Rhode Island, New Mexico and Wisconsin. In 2013-14, 4 F6 lines were planted at the same 3 Washington locations. In 2014, the best lines will be released to the public.

Table 1. Marketable yield (g) from 10-foot row of edamame varieties included in WSU variety trials in southwest Washington from 1995 to 2002; overall average for each variety; and overall mean each year.

Variety	Marketable pod yield (g/10 row-ft)								Avg.
	1995	1996	1997	1998	1999	2000	2001	2002	
Beer Friend								1106	1106
Buker's Favorite				2079			1687		1883
Butterbeans	663	770	617	1649	327	501	1088	1156	846
Early Hakucho	495	120	468						361
Envy	332		379			478	755	1389	667
Fiskby	631	61							346
Gion	687	321	735		198	753	190		481
Haruno-Mai/SB 1002					90	341	603	1447	620
IA-1010								2217	2217
IA-1011								1775	1775
IA-2040 LF								1287	1287
JSMO 168		663							663
JSY 1004		884							884
JYKO 189		536							536
Kegon			1382	1270			846		1166
Kenko (SE-4)					95	778			437
Kitanosuzu					226	923	1285	1535	992
Lucky Lion	614	736	593	450	183	625	570		539
Mana								1379	1379
Mikawahima 202			321						321
Miki								708	708
Misono Green				1602			1228	1457	1429
Osodefuri 200		472							472
Sapporo Midori		408	397		138	431	446	1343	527
Sayakomachi							791	1945	1368
Sayamusume	699			1945	202	852	591	1706	999
Shirofumi	220		586				649		485
Shironomai	743	728	931			835	480		743
Soya # 203			360						360
Tokita 214		22							22
White Lion	810	731	585		212	324	644		551
Yukimusume					154	529	742	1385	703
Mean	589	496	613	1499	183	614	787	1380	745