

Edible Soybean Variety Evaluations

Robert Kratochvil
Extension Specialist-Field Crops
University of Maryland

The Maryland Soybean Board provided funding for the continuation during 2002 of food soybean variety evaluations in Maryland. This project had two objectives.

Project Objectives:

- I. Evaluate “edible” soybean varieties and lines for yield and agronomic performance in full-season, double-crop, and organic vs conventional dry bean production systems.
- II. Evaluate a select group of “edible” soybean varieties for green pod production.

Objective I.

Full Season Production

Twenty-one food soybean varieties and elite breeding lines (Table 1) were grown under full season production in a replicated (3) field trial at Wye Research and Education Center. Included in the 2002 test were a number of the commonly grown industry standards for food soybeans including the widely accepted variety, Vinton 81. Two natto type soybean varieties (MFS 516 and 553) that are marketed to Japan by Montague Farms (Montague, Virginia) were added to the test this year. Producers representing Chesapeake Fields Institute contracted nearly 500 acres with Montague Farms during 2002 creating additional interest in the performance of the natto bean in Maryland. Natto soybean is uncharacteristic of most food soybean varieties in that the seed size is quite small. Another line of particular interest was the Japanese L1,L2,L3 line that has had the three lipoxygenase enzymes removed. This line has particular interest for the soyfood industry because these lipoxygenase enzymes are responsible for the beany flavor found in soybean protein. Two black hulled varieties (SK 9401 and Tamba) were included for the first time during 2002. They were submitted to the test by Chesapeake Fields Institute on behalf of SK Food International located in Fargo, North Dakota. SK Food International is an import/export trading company that has a market for the black-hulled soybeans in Japan. These two entries were submitted to determine their adaptability to Maryland’s growing conditions. Lastly, Dr. Bill Kenworthy included a number of the elite breeding lines that represent the modified oil types that are being developed by he and six other public breeders in the United States. The goal of this multi-state research project is to develop varieties that have lower saturated fatty acids, lower poly-unsaturated fatty acids and higher protein content.

The 2002 growing season was highlighted by drought that affected the crop performance. Little rain fell during much of a summer that had periods of extremely hot weather. Late summer rains allowed some of the later maturity group entries to set more pods and get better pod fill. In Table 1 it can be seen that entries of maturity groups IV and V performed better, in general, than the earlier maturity group’s entries explaining why food soybean standard varieties like Vinton 81 and FG-1 did not perform as well as they usually do in Maryland. Added to the effects of the drought was the impacts of a wet harvest season that affected both timely harvest and seed quality. Due to the poor seed quality prevalent with the 2002 crop, no samples were

collected for seed quality and seed size analysis. The only data collected for the full season production study was yield (Table 1).

Table 1. Yield for full season food soybean variety test conducted at Wye Research and Education Center during 2002.

Variety	Maturity Group	Yield
		-----Bu/ac-----
MFS 516	V	42.9
MD 99-5464	IV-S	38.4
MFS 553	V	37.4
MD 86-5788	V	37.2
R-95-1705	V	34.5
MD 99-6701	IV-S	34.0
MD 99-5433	IV-S	31.8
Stressland	IV	31.4
MD 94-5463	IV	31.1
BARC-7	V	29.1
Japanese L1,L2,L3	IV-S	26.3
FG-3	III	24.0
SK 9401	III or IV	22.7
MD 99-173-11	IV-S	22.1
Suzuyutaka	V	21.2
Vinton 81	II	20.9
FG-1	III	19.8
IA 3001	III	17.2
Fukungaha	V	16.9
Jack	III	14.3
Tamba	Tropical origin	2.1
LSD _{.05} =		5.2
Average		26.5

Double Crop Production

Sixteen and twelve of the entries (Table 2) used in the full season study were grown under double crop production at Wye Research and Education Center and Lower Eastern Shore Research and Education Center-Poplar Hill Facility, respectively. Yield performance for the entries in these two tests (Table 2) were comparable to the full season study. The two, natto varieties performed particularly well under both full season (Table 1) and double crop production (Table 2). The industry standard, Vinton 81, ranked at the bottom of the double crop tests primarily because of the drought effect on this maturity group II soybean variety.

Table 2. Performance of a select group of food soybean varieties produced under doublecrop production at Wye and Poplar Hill during 2002.

Variety	Maturity Group	Wye	Poplar Hill	Two Location Average
MFS 516	V	38.9	40.0	39.5
BARC-7	V	34.8	33.3	34.1
MFS 553	V	25.5	41.7	33.6
Stressland	IV	28.4	37.3	32.9
Suzuyutaka	V	34.5	30.1	32.3
Japanese L1,L2,L3	IV-S	29.9	31.7	30.8
FG-1	III	34.3	16.5	25.4
IA 3001	III	25.4	24.0	24.7
FG-3	III	23.9	19.0	21.5
SK 9401	III or IV	27.8	15.1	21.5
Jack	III	17.8	23.8	20.8
Vinton 81	II	16.0	15.0	15.5
C 1981	??	31.7	N/A	N/A
MD 86-5788	V	31.4	N/A	N/A
MD 99-5464	IV-S	28.6	N/A	N/A
MD 99-173-11	IV-S	24.3	N/A	N/A
LSD _{.05} =		5.2	6.1	
Average		28.3	27.3	27.9

Organic vs. Conventional Study

As part of a statewide program to develop field sites for organic production research, Ron Mulford at the LESREC-Poplar Hill Facility has established a site where a long-term comparison between organic and conventional production of corn and soybeans can be evaluated. It was decided to utilize this field site during 2002 to evaluate the performance of the 21 food varieties and lines tested in the full season study in a side by side organic vs. conventional comparison (Table 3). As can be seen by the average yields obtained from this study, there were numerous production problems. The plots were planted during late May. After emergence, the plants were subjected to heavy damage by geese feeding. Little rainfall was seen at this location during the summer causing considerable drought stress in both the organic and conventional plots. Rainfall was very abundant during the fall harvest season and because this site is on a soil type that does not dry quickly following frequent rain events, the harvest of these plots was continually delayed. The site did not become suitable for machine harvest until January following a period of cold weather that allowed the soil to freeze. All of the above contributed to uncharacteristically low yields (Table 3) for both production systems.

Table 3. Yield results for organic vs. conventional food soybean variety test conducted at Poplar Hill during 2002.

Variety	Maturity Group	Organic	Conventional	Combined
		-----Yield in bu/ac-----		
R-95-1705	V	11.2	11.2	11.2
Japanese L1,L2,L3	IV-S	11.6	10.5	11.1
MFS 553	V	12.6	7.7	10.2
MD 99-5433	IV-S	7.9	10.5	9.2
MD 99-5464	IV-S	9.7	7.1	8.4
Stressland	IV	8.1	7.7	7.9
MFS 516	V	5.2	8.9	7.0
FG-3	III	8.1	4.6	6.4
FG-1	III	6.5	3.6	5.1
MD 99-6701	IV-S	3.8	5.9	4.8
MD 94-5463	IV	2.1	7.3	4.7
Suzuyutaka	V	4.8	3.7	4.3
Fukungaha	V	3.0	5.0	4.0
MD 86-5788	V	5.1	1.6	3.4
SK 9401	??	2.9	3.8	3.4
Vinton 81	II	3.3	2.8	3.1
MD 99-173-11	IV-S	4.5	1.6	3.1
IA 3001	III	4.5	0.8	2.6
Tamba	??	2.6	1.4	2.0
Jack	III	1.9	2.1	2.0
BARC-7	V	3.4	0.5	1.9
Average		5.8	5.2	5.5

Objective II:

Research Goal:

Edamame (green pod soybean) is a favored way to consume food soybeans among Asian cultures. Green pod production requires some different management practices than dry soybean production in order to obtain quantity and quality edamame. It was apparent from the green pod assessments made during 2001 at the Central Maryland Research and Education Center-Upper Marlboro Facility that the normal planting rate of 175,000 seeds per acre was too great to obtain acceptable green pod production. The most limiting factor with that seeding rate was the high number of plants that had few or no pods. This 2002 study evaluated two seeding rates (35,000 plants/acre and 70,000 plants/acre) for eight edible soybean varieties. The lower seeding rate has been identified as the optimum for edamame production by researchers at Washington State University.

According to Washington State researchers, the optimum time to harvest green pod soybeans is when they have attained maximum size but have not yet reached physiological

maturity (when the pods no longer have a green color). Each variety in the edamame test was monitored closely during seed fill to identify this stage of maturity. Harvest of each variety was done when this stage was reached. Harvest consisted of randomly pulling 5 plants from one of the two center rows of each four-row plot. The traits that were measured were:

- Number of pods/plant
- Number of pods with 2 or more beans (considered the market ideal)
- Number of pods with 1 bean
- Weight of marketable pods
- Weight of single bean pods
- Weight of unmarketable pods
- Yield was calculated from the weight/plant of marketable beans multiplied by the harvest population.

Results

Averaged over the eight varieties, green pod production at a planting rate of 70,000 seeds/acre was over double (Figure 1) the production harvested from a population of 35,000 seeds/acre. This is contrary to the Washington State report indicating that the lower population was more suitable for edamame production. A comparison of yield performance among the varieties indicates that the Japanese variety, Suzuyutaka, performed best (Figure 1). Other top producing varieties were FG-1 from Ohio, the Japanese variety, Funkungaha, and Envy. Vinton 81, a food soybean industry standard from Iowa, was the poorest yielding of the eight varieties tested.

One important yield and quality component for green pod soybean production is the number of marketable pods that are present on each plant. Averaged over the eight varieties, there were no differences for number of marketable pods between the two seeding rates. This was the primary reason why the greater seeding rate produced over twice the yield. The variety FG-1 produced the most marketable beans/plant (Figure 2).

One reason Suzuyutaka proved to be such a high yielding variety was because of its large seed size. Both it and Funkungaha had an average pod weight of 2.25 grams. This was nearly 0.5 gram/pod more than Vinton 81. It is this investigator's opinion, that the larger sized food soybean varieties offer the most potential for edamame production.

Discussion

Harvesting soybeans for edamame at the proper stage of maturity is critical to obtain good quality. A disadvantage to this is that the harvest window is quite narrow. In generally less than a week the pods reach and exceed the most desirable stage. In order to extend the harvest period for edamame production, a series of planting dates will have to be utilized. For a particular variety, planting on a weekly basis from early May through early July should easily allow for good quality, green pod soybeans to be harvested from as early as late August through early October. Another management tactic that will extend the harvest window will be to inclusion of varieties that represent a range of maturity groups. The best maturity groups for Maryland conditions will be II through V.

Figure 1. Yield in pounds/acre for eight varieties of food soybeans harvested for edamame (green pod) production produced at two different plant populations at the Central Maryland Research and Education Center-Upper Marlboro Facility during 2002.

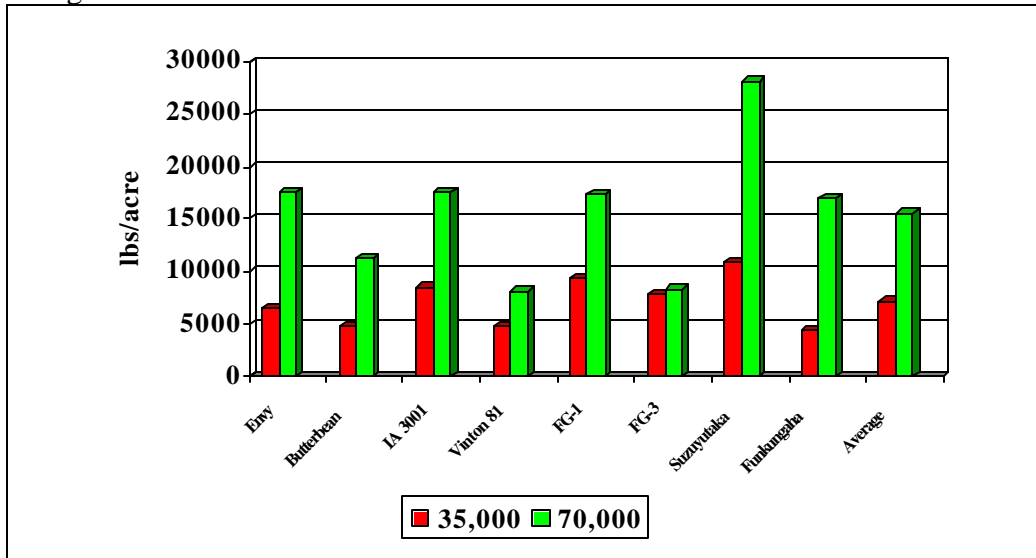
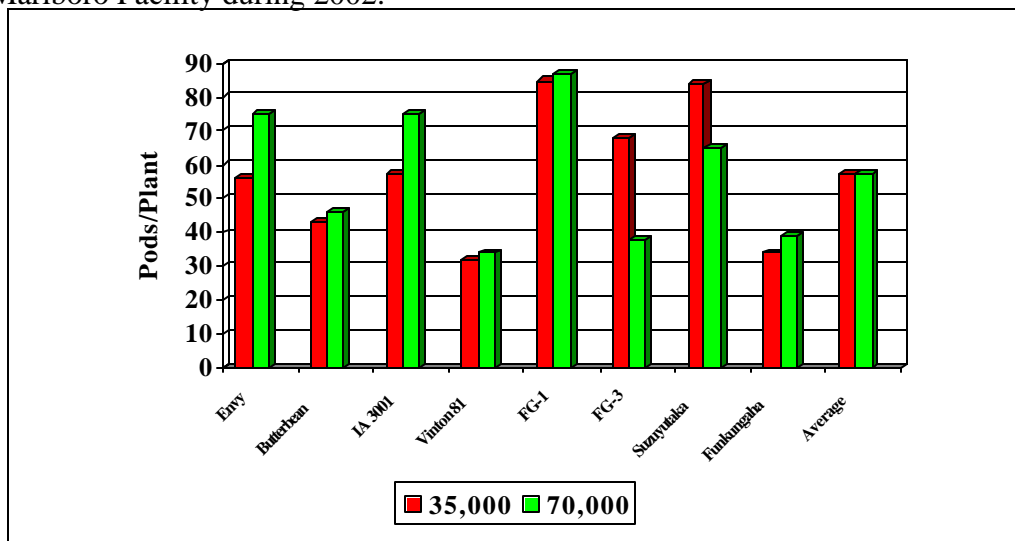


Figure 2. Number of marketable pods/plant for eight varieties of food soybeans harvested for edamame (green pod) production produced at two different plant populations at the Central Maryland Research and Education Center-Upper Marlboro Facility during 2002.



One additional activity that was undertaken as a supplement to this project was an unscientific, post-harvest handling and taste test. Samples of approximately five pounds of marketable pods for each of the varieties were first washed and then blanched for two minutes. When the two-minute blanching is complete the pods should be immediately drained using a strainer and cooled by running cold water over them. It is very important to not blanch the pods longer than two minutes. Over-blanching the pods causes an inner layer of the pod wall to form

into a plastic-like material. This sheath tends to separate from the rest of the pod when the beans are removed from the pod either by hand or by stripping them with your teeth if you are eating them as a snack. The final step was to place the pods into quart plastic freezer bags and freeze them.

A personal taste test for each variety was done while the beans were still warm following the blanching. The beans had a pleasant, nut-like flavor. This investigator found little difference in taste among the 8 varieties. The larger sized varieties like Suzuyutaka and Funkungaha were preferred. Samples have been removed from the freezer periodically since September and eaten. They have kept very well in the freezer and seem to have lost little flavor.

Edamame production is probably best suited for the home gardener. A good supply of edamame can be obtained from production on a relatively small garden site. In order for larger scale production to become a reality, a way to harvest the beans mechanically will be required.