

Project Title: Flageolet and Edamame beans: developing new crops for the UK processing and fresh market industry

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'The results and conclusions in this report are based on an investigation conducted over one year. The conditions under which the experiment was carried out and the results obtained have been reported with detail and accuracy. However because of the biological nature of the work it must be borne in mind that different circumstance and conditions could produce different results. Therefore, care must be taken with interpretation of the results especially if they are used as the basis for commercial product recommendations'.

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GROWER SUMMARY

Headline

Trials have shown that Edamame soya can be grown successfully but mechanical shelling remains difficult, though suitable machines exist in the Far East.

Preliminary results suggest that Flageolet beans are a suitable crop for UK production.

Background

- **Challenges**
To develop new crops for the UK processing and fresh market industry

- **Opportunities**
Both Flageolet beans and Edamame soya beans could be of particular interest to:
 - a, existing vining pea or combining pea growers and also green bean producers who have the necessary machinery for drilling and harvesting.
 - b, existing fresh market growers of green beans and garden peas.
 - c, organic growers.

- **Need for the project**
The search for new crop opportunities by vegetable growers has been highlighted in a recently commissioned HDC project (CP49 New Crop Opportunities).

Summary

Of the two species tested, Edamame soya bean is the one that has proved to be the most difficult to establish as a potential commercial proposition. The crop can be grown successfully in the UK, however harvesting is more challenging. The crop can be harvested by green bean harvesters at the pod stage, but the challenge is to remove the beans from the pod. In the Far East podding machines are available but not in the UK. Further work is in progress to assess the feasibility of harvesting the crop with pea viners.

Several varieties of Edamame yield well at the pod and the shelled stage. Both products have a market and there appears to be further potential for both in-shell and podded

Edamame. Although again further work will help to establish the correct viable harvest stage between product quality and maximum yields and to increase the availability of pesticides and herbicides.

In contrast, Flageolet are proving to be relatively easy to produce at all stages of harvest. The crop can be harvested at both green and dry stages and yields are commercially viable at both.

There is a good range of varieties available and approved pesticides are available in the UK, along with a large potential import market to attack.

Work is continuing to ascertain the optimum sowing times and densities.

Potential Financial Benefits

- Enabling growers and processors to make informed decisions as to the feasibility of Flageolet or Edamame Soya bean production in the UK.
- Such production will enhance the diversity of production of beans in the UK
- Reduce the import dependence
- Offer new opportunities for production of a new type of vegetable for several sectors of the UK horticultural industry.

Action Points for Growers

- At the moment it is not recommended that growers consider producing Edamame.
- Consider Flageolet beans on medium to light soil types where they can be harvested with existing vining pea equipment
- The final part of this project will be to evaluate both the species in small scale farm trials.

SCIENCE SECTION

Introduction

This project will provide an opportunity for horticultural producers to supply into the traditional markets to substitute imports and to widen the range of crops available. The aim of the project is to evaluate a range of non GM varieties of Flageolet and Edamame beans in replicated small plot trials and to evaluate these in small farm trials with commercial growers using commercial harvesting equipment. In addition, if successful, the results will form the basis of developing crop growing and processing guidelines for both fresh market producers and for the processed crops.

Materials and Methods

A series of field studies to determine the feasibility of growing Flageolet and Edamame in replicated trials were set up at 4 locations using a range of varieties on field scale trials and a plot trial series grown at PGRO.

In trials 1 and 2 the drill used; - Oyjord drill.

In trials 3 and 4 drills to be used; - Oyjord drill
- Vaderstadt Rapid A

The site details are as follows:

Trial 1	PGRO: Great North Road, Thornhaugh, Peterborough, PE8 6HJ OS Number: TF 074 010
Plot trials	Soil type: sandy clay loam
Edamame	Sowing date: 18.05.07 Harvest date: from the 20.09.07
Trial 2	PGRO: Great North Road, Thornhaugh, Peterborough, PE8 6HJ OS Number: TF 074 010
Plot trials	Soil type: sandy clay loam
Flageolet	Sowing date: 23.05.07 Harvest date: from the 11.09.07
Trial 3	J Scholes Farms, Green Lane Farm, Nafferton, East Yorkshire, YO25 4LF.
Commercial trial	Contact: Mr Richard Scholes. Tel: 01377 256710. Mob: 07850 504 090.
Edamame	OS Number: Soil type: Sowing date: Not sown due to continual adverse weather conditions, is now planned for 2008
Trial 4	Crane and Sons (Farms) Ltd, Wood Farm, Marsham, Norfolk. NR10 5QQ
Commercial trial	OS Number:
Flageolet	Soil type: Sowing date: Not sown due to continuing adverse weather conditions, is now planned for 2008

Trial layout PGRO:

Trial 1 - Edamame: 10 coded varieties were obtained and established in randomised 10m x 1.83m plots x 3 replications. Plant establishment was aimed at 40 plants m².

Trial 2 - Flageolet: 8 named varieties were obtained and established in randomised 10m x 1.83m plots x 4 replications. Plant establishment was aimed at 35 plants m².

In both species, assessments of plant population, evenness and uniformity of emergence where made.

Just prior to harvest, 10 plants were sampled from the plots and measurements of yield components including pods per plant, seeds per pod, pod length and seed size was recorded.

In trial 1, the Edamame plots were then harvested by a Ploeger bean harvester, pods were weighed, then hand podded and the beans weighed and processed frozen for later inspection for appearance using a 1 to 9 scale.

Maturity was assessed from the samples using a Martin Pea Tenderometer.

In trial 2, the Flageolet plots were harvested by hand. Threshed in a plot pea viner, washed and total yield measured. Samples of each variety were both processed frozen and canned for later inspection using a PGRO tasting panel judging size, breakdown, gel, texture and flavour.

Maturity was assessed by the standard oven method for assessing dry matter content.

Statistical analysis of yield was carried out using analysis of variance (Genstat5).

Results

Trial 1 - Edamame - Thornhaugh – Tables 1 & 2

10 varieties covering a range of maturities were assessed in the trial.

As there are no UK approved insecticide seed treatments, all seed was treated abroad by the suppliers with chlorpyrifos and thiram seed treatment to control bean seed fly (*Delia platura*) and damping off diseases. The trial was sown on the 18th May, into a fine, moist seedbed.

Broad-leaved weeds were controlled with Alpha Trifluralin 48 EC at 1.7 l/Ha pre-crop emergence.

April and the first half of May were very dry. Immediately after sowing, the rest of May became very wet and the rainfall for the month was 200% higher than average. June, July and Augusts temperatures were below average, or average with hardly any sunshine hours.

This weather pattern led to very slow growth in the Edamame plant, fortunately September became very dry and warmer and the crop was able to develop more normally.

Harvesting started on 20th September and was completed by the 27th September. Unfortunately we had to harvest 4 varieties slightly early due to an aggressive attack of rabbits despite the use of rabbit fencing.

In addition to the standard harvesting methods, some hand pulled plants from the guard rows were put through a static pea viner, this was to see if it was possible to “vine” Edamame. It appeared to work, though losses are relatively high and this form of harvesting will be further investigated in 2008.

PVSL ED 13 Maturing in 118 days, PVSL ED 13 was 9 days earlier than any other variety. The yield of both pods and beans was very low.

PVSL ED 1 The second earliest variety in the trial maturing in 127days. Plants were short in height, however bean and pod set were good. This variety had a lower poulation due to poor germination of the seed.

The yield of beans was the same as the trial average of 1.59 tonnes/ha.

PVSL ED 8 The third earliest variety in the trial maturing in 128 days. PVSL ED 8 produced below average yields of both pods and beans. Beans appear to have discoloured after processing and storage.

PVSL ED 7 One of the tallest varieties in the trial with some lodging, PVSL ED 7 matured in 129 days. Yields of both pods and beans were very disapointing. This low yield was partly due to the fact that the bean seed size was the smallest in the trial, however they were judged to be very attractive.

PVSL ED 6 Maturing in 129 days, PVSL ED 6's plants were tall and the bottom pods were held high up the plant. The plants produced a lot of branches. Both the yields of pods and beans was higher than the trial average.

In fact the bean yield was signifcantly higher by 0.95 tonnes/ ha, than the lowest yielding variety in the trial.

PVSL ED 11 Also maturing in 129 days, with a short plant type. PVSL ED 11 produced the highest yields of large fleshy pods and beans in the trial of both pods and beans. Both significantly outyielding the lowest yielding variety in the trial.

PVSL ED 9 The earliest of a later maturing group of varieties, maturing in 134 days. PVSL ED 9 had a vigorous plant type producing several branches and excellent looking pods and beans. With above average yields of beans and pods, in fact it was the 3rd highest yielding variety of shelled beans.

This variety was the best for appearance of all varieties.

PVSL ED 16 Maturing in 137 days, PVSL ED 16 had a tall vigorous plant type producing average yields of both pods and beans. This variety was one of those taken early because of the influx of rabbits, this has influenced the potential yield of the variety.

PVSL ED 5 Maturing in 139 days, PVSL ED 5 had an attractive field appearance producing good quality pods. It produced below average yields of both pods and beans. This variety was one of those taken early because of the influx of rabbits, this has influenced the potential yield of the variety.

PVSL ED 10 Also maturing in 139 days, PVSL ED 10 was the tallest variety in the trial producing masses of pods. Yield of pods was significantly higher than several varieties in the trial. Whilst the yield of shelled beans was below average.

This variety was one of those taken early because of the influx of rabbits, this has influenced the potential yield of beans from this variety.

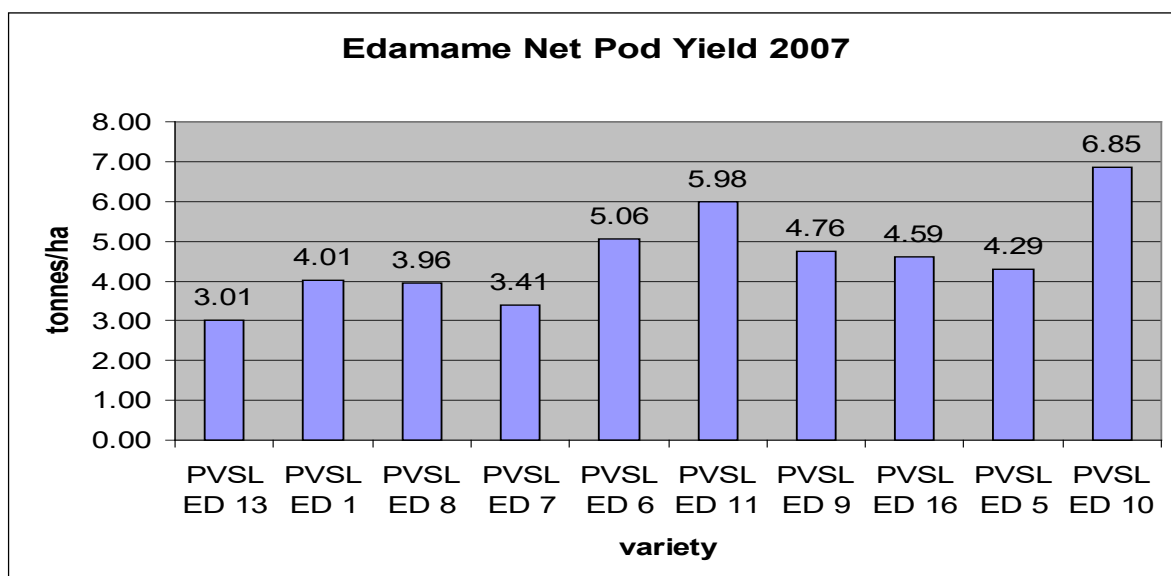
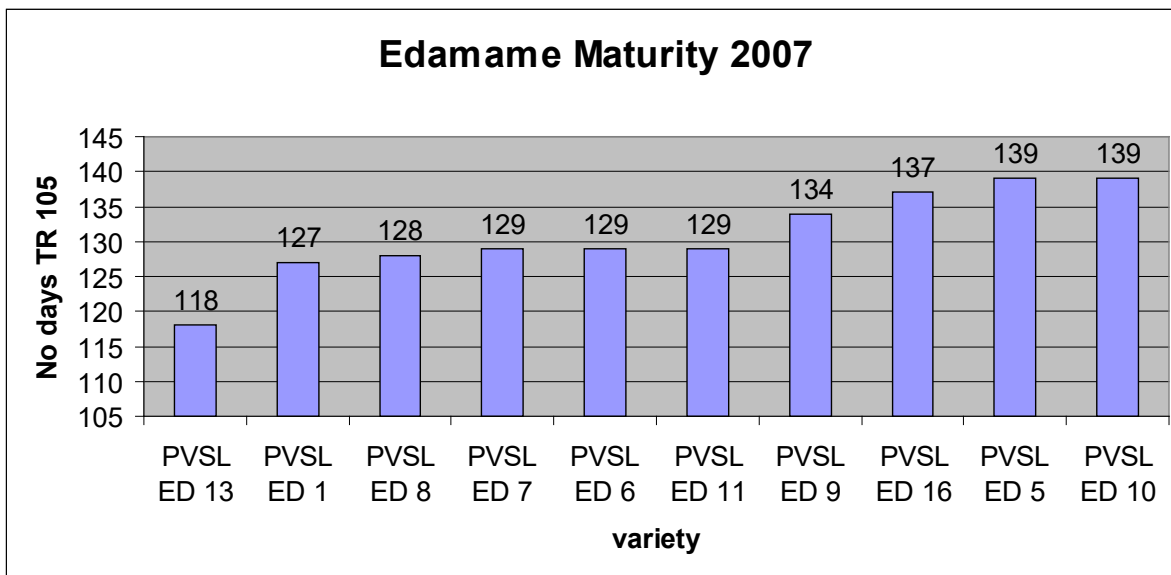
TABLE 1 – Summary of agronomic data - 2007

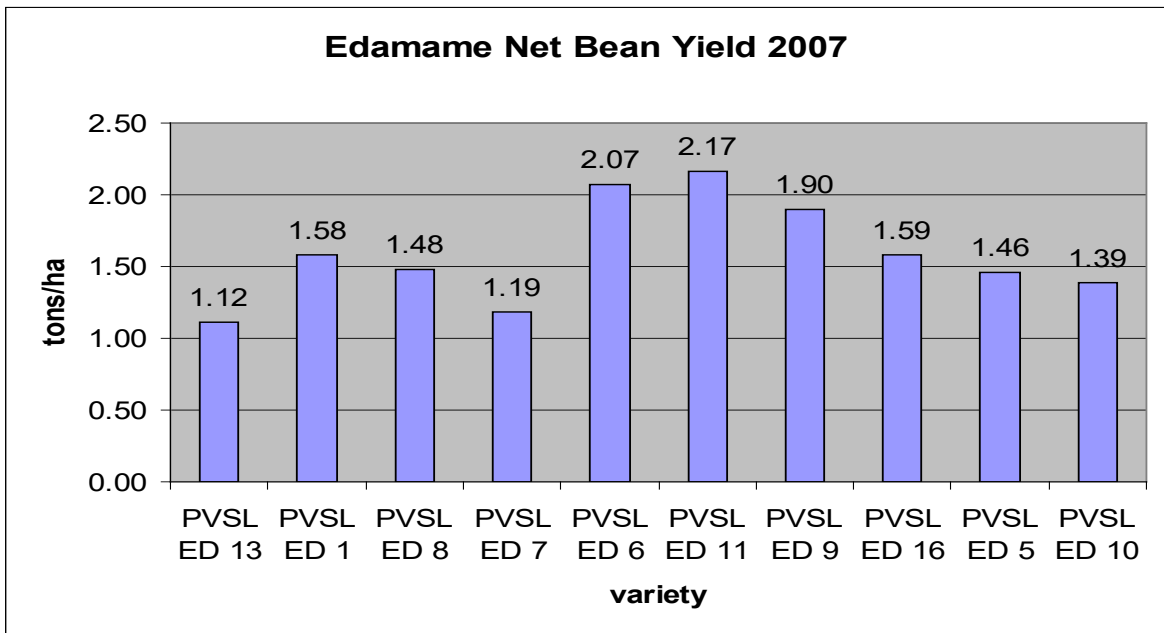
Varieties placed in order of maturity at corrected TR 105.

Target population 40 plants per m². Row width 25 cm. Sown 18th May 2007.

Variety	Source	1000 seed weight (g)	Plants per m ²	Harvest							Pod characteristics						
				Harvest date	No days to harvest	TR	No days corrected to TR 105	Pod yield Tonnes/Hectare	Bean yield Tonnes/Hectare	% bean to pod ratio	Plant height (cm)	Height bottom pod (cm)	No pods per plant	Length (cm)	Width (cm)	No beans per pod	10 seed length mm
PVSL ED 13	ProVeg	389.4	37	20 th sept	124	120	118	3.01	1.12	37.0	48.5	11.3	20.9	5.6	1.4	2.2	43.6
PVSL ED 1	ProVeg	384.4	20	27 th sept	131	116	127	4.01	1.58	38.2	34.1	11.6	20.9	5.6	1.5	2.1	43.0
PVSL ED 8	ProVeg	217.4	35	26 th sept	130	111	128	3.96	1.48	37.2	46.4	11.0	32.7	4.9	1.3	2.1	43.8
PVSL ED 7	ProVeg	166.7	40	26 th sept	130	108	129	3.41	1.19	33.4	54.4	12.4	28.8	4.8	1.1	2.5	43.1
PVSL ED 6	ProVeg	366.2	37	27 th sept	131	110	129	5.06	2.07	41.5	49.5	16.0	28.3	5.7	1.4	2.3	47.8
PVSL ED 11	ProVeg	375.4	36	26 th sept	130	109	129	5.98	2.17	36.2	36.1	12.7	12.0	5.6	1.5	2.3	47.3
PVSL ED 9	ProVeg	333.3	39	27 th sept	131	97	134	4.76	1.90	39.1	48.6	13.8	43.9	5.8	1.4	2.3	42.9
PVSL ED 16	ProVeg	340.0	37	27 th sept	131	90	137	4.59	1.59	33.4	51.3	16.9	21.3	5.4	1.4	2.1	43.0
PVSL ED 5	ProVeg	282.7	34	27 th sept	131	84	139	4.29	1.46	33.2	46.3	13.2	30.2	5.8	1.4	2.3	44.2
PVSL ED 10	ProVeg	327.1	40	27 th sept	131	84	139	6.85	1.39	18.7	57.6	12.7	34.9	5.9	1.5	2.4	37.8
LSD @ P = 0.05								2.851	0.8404								
Probability								< .001	< .001								
CV%								36.2	30.7								

Table 2 - maturity and yield





Flageolet - Thornhaugh – Tables 3 - 6

8 varieties covering a range of maturities were assessed in the trial

As there are no UK approved insecticide seed treatments, all seed was treated abroad by the suppliers with chlorpyrifos and thiram seed treatment to control bean seed fly (*Delia platura*) and damping off diseases. The trial was sown on 23rd May, into a fine, moist seedbed.

Broad-leaved weeds were controlled with Alpha trifluralin 48EC 1.7 l/ha.

April and the first half of May were very dry. Immediately after sowing, the rest of May became very wet and the rainfall for the month was 200% higher than average. June, July and Augusts temperatures were below average, or average with hardly any sunshine hours. September became very dry and the crop became dehydrated very rapidly, causing the dry matter to progress very rapidly from 40% to 65% in a matter of days.

Maturity is judged by % dry matter and the best quality by maximum yield is generally achieved at around 46%DM.

As a result of this rapid dehydration, the trial was harvested all on the same day, as this was the only way that circumstances would allow. With the wide range of dry matters we were able to calculate the maturity order.

Harvesting was done by hand with the plots being pulled up and then hand fed through a static mini plot pea viner.

This worked extremely well and the samples were then canned and frozen for later inspection.

Flaforte. Judged to be the earliest variety at this stage of harvest. Flaforte had a tall erect plant habit with no pods touching the soil.

Yield was a little disappointing, it being lower than the trial average. However none of the yields from any variety were significantly different. The canned product was judged to have a reasonable quality.

Fleuron. This variety appeared quite early maturing, with below average yields. The plant habit was poor with a lot of pods touching the soil, however it had the highest number of pods per plant, of any variety and pod shape was very good.

The quality of the canned product was judged to be good and the colour of the product was the best in trial.

Univert. Yields were just below average, plants were quite tall, producing long slender pods which were held low on the plant. Univert was difficult to pod in the viner producing a lot of leaf and stalk in the sample.

The quality of the canned product was judged to be very good, much better than the purchased commercial samples.

HS 117. This variety was a good average around variety, producing quite a bold sample.

The canned product was judged to be really good in most aspects.

Flamenco. Produced a vigorous plant and in most aspects recorded, was a good around variety. Yields were above average.

The quality of the canned product was judged to be very good, much better than the purchased commercial samples.

Flavert. Had a good plant habit holding the pods quite high up. The plants had a large number of very slender pods producing a good yield equal to the trial average.

The quality of the canned sample was judged to be good in all aspects except for its evenness of size.

Flagrano. This variety produced the highest yield in the trial. In general the plant habit etc was fairly good, it did however put a lot of its pods on the soil.

The quality of the canned sample was judged to be poor, with flavour being the lowest in the trial.

Fasal. Judged to be the latest maturing in the trial, Fasal's plant habit and pod characteristics were average. The yield was above average and the canned product was judged to be very good.

TABLE – 3: Summary of agronomic data – 2007

Target population 35 plants per m². Row width: 25 cm Sown: 23rd May. Harvest: 11th September.

Variety	Source	1000 seed weight (g)	Plants per m ²	Plant height (cm)	Harvest					Pod Characteristics							
					No days to harvest	% dry matter	Haulm and pods Tonnes/Hectare	Bean net yield Tonnes/Hectare	% bean to haulm ratio	Height bottom pod (cm)	No on soil (1-5)	No per plant	Average shape (1-5)	Average length (cm)	Average width (mm)	No beans per pod	Seed length mm
Flaforte	Pop Vriend	200	30	29.5	111	64.4	17.53	3.74	21.3	15.2	5.0	24.6	4.5	12.4	7.6	6.0	11.7
Fleuron	Holland Select	210	33	28.2	111	61.7	16.13	3.67	22.8	11.6	3.8	26.8	5.0	12.0	7.8	5.4	12.6
Univert	Nickerson Zwaan	209	33	30.2	111	60.0	13.13	3.76	28.6	12.6	4.5	24.3	4.5	12.9	8.2	6.3	12.5
HS 117	Holland Select	191	35	28.8	111	58.6	17.80	4.02	22.2	11.3	4.3	19.7	4.5	12.0	7.9	6.0	11.7
Flamenco	Pop Vriend	200	35	27.5	111	58.3	18.47	4.29	23.2	12.3	4.3	15.9	4.0	12.2	8.0	5.8	11.0
Flavert	Nickerson Zwaan	195	31	27.3	111	58.2	15.67	4.07	26.0	13.6	4.3	20.5	4.5	11.5	6.4	6.4	11.1
Flagrano	Holland Select	204	29	27.0	111	58.1	17.47	4.52	25.8	9.6	3.5	15.8	4.0	12.6	7.6	5.9	11.8
Fasal	Nickerson Zwaan	179	31	27.0	111	52.8	16.93	4.20	24.9	12.2	4.3	17.6	4.5	12.0	7.3	5.9	11.8
LSD @ P = 0.05							5.836	1.769									
Probability							0.424	0.644									
CV%							23.8	29.8									

Note.

Pod Shape: 1 = v. curved, 5 = straight. Pods on soil: 1 = most, 5 = none

Table - 4 Quality appraisal of fresh canned product

Variety	Size compared to Daucy product	Evenness of size	Breakdown and splitting 5=none 1=v.bad	Gel	Texture 5=good 1=poor	Flavour 5=good 1=poor	Remarks
Flamenco	same	even	4.0	present/clear	4.0	4.0	ok
Flaforte	same	even	4.0	present/clear	3.5	4.5	ok
Flagrano	larger	even	5.0	present/cloudy	3.5	2.0	ok
Fleuron	same	even	5.0	present/cloudy	3.5	4.0	good colour
HS 117	larger	even	5.0	present/cloudy	4.0	4.5	really good +
Flavert	same	uneven	4.0	present/clear	4.0	4.5	good
Univert	same	even	5.0	present/clear	4.0	4.5	very good +
Fasal	same	even	4.5	present/clear	4.5	5.0	very good ++
Daucy commercial brand	-	uneven	3.5	present/cloudy	3.0	3.0	thick gel
Asda commercial brand	larger	even	4.0	present/clear	3.5	3.0	watery

Table - 5 Maturity

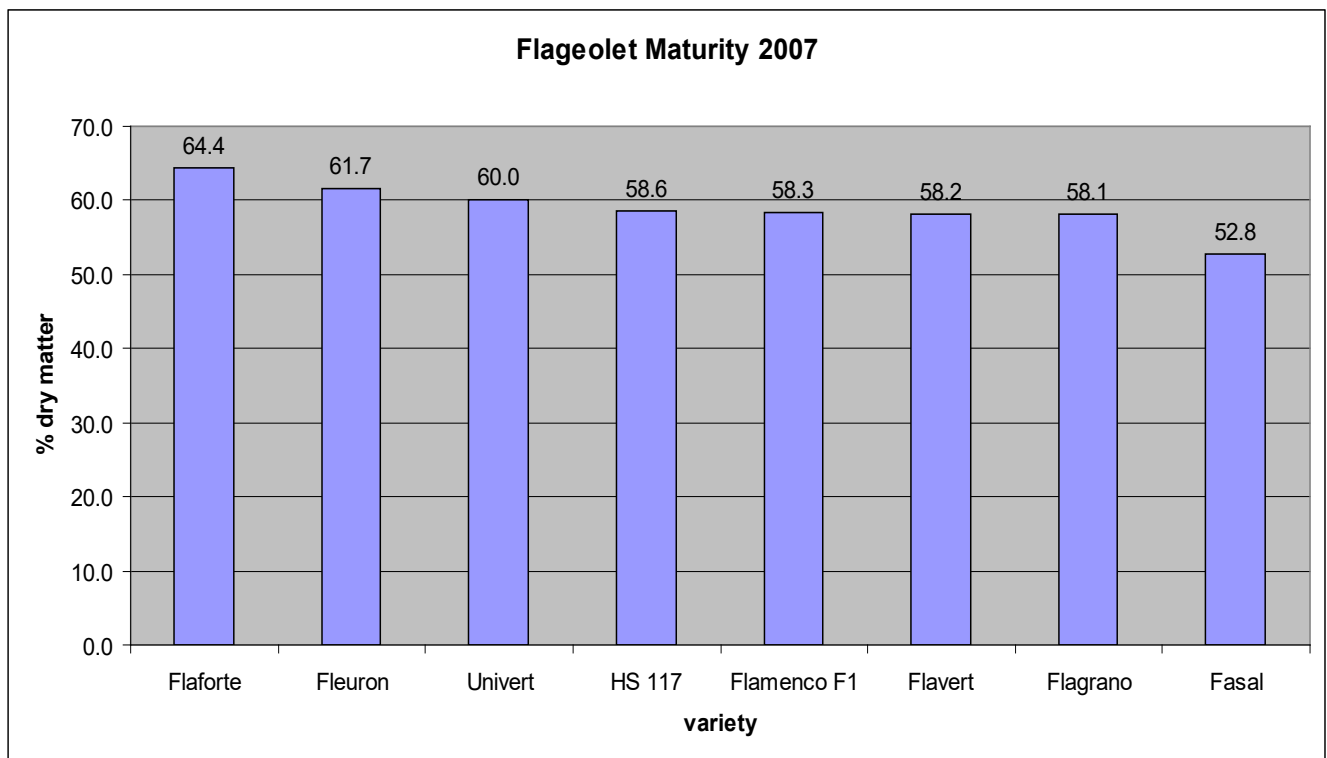
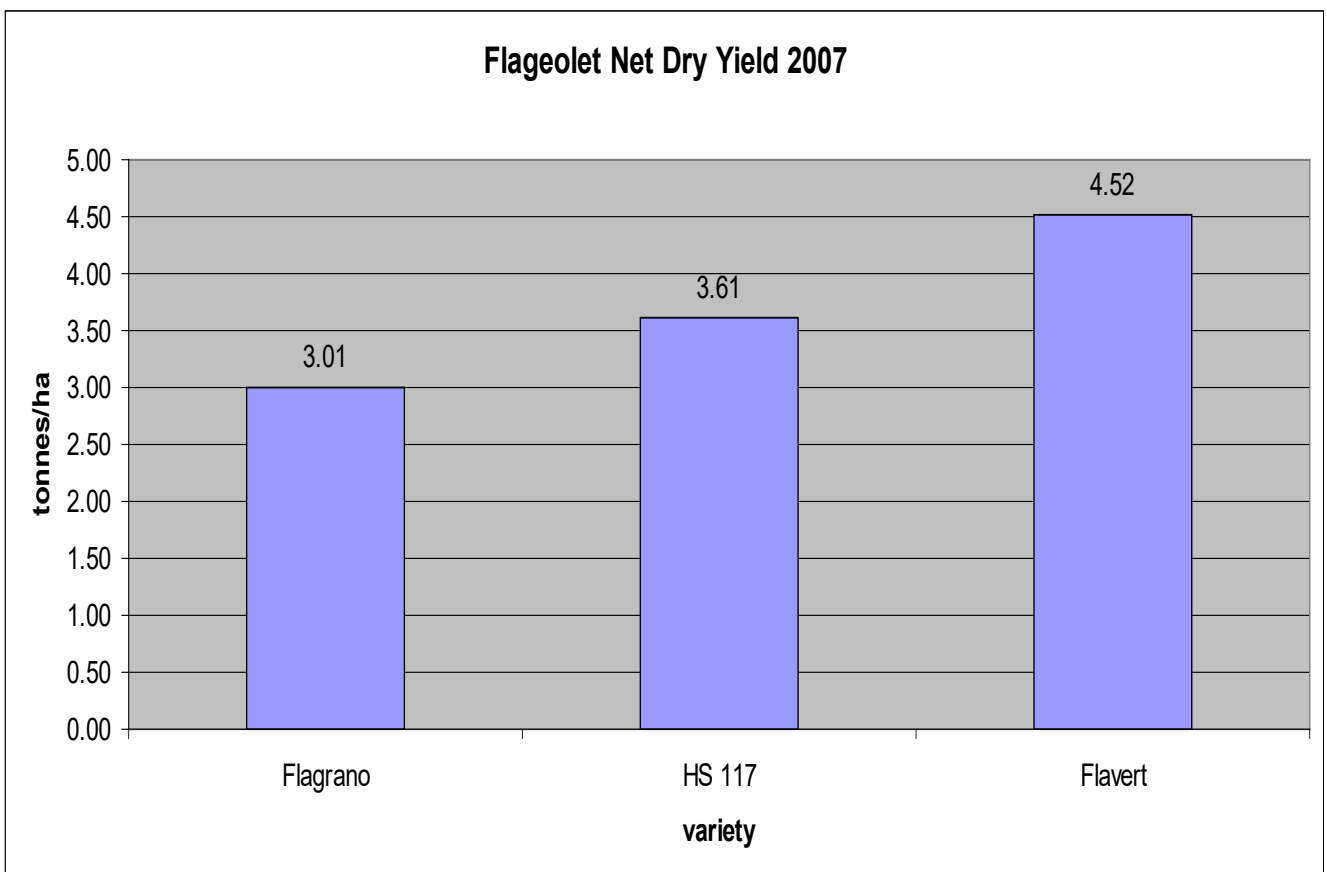
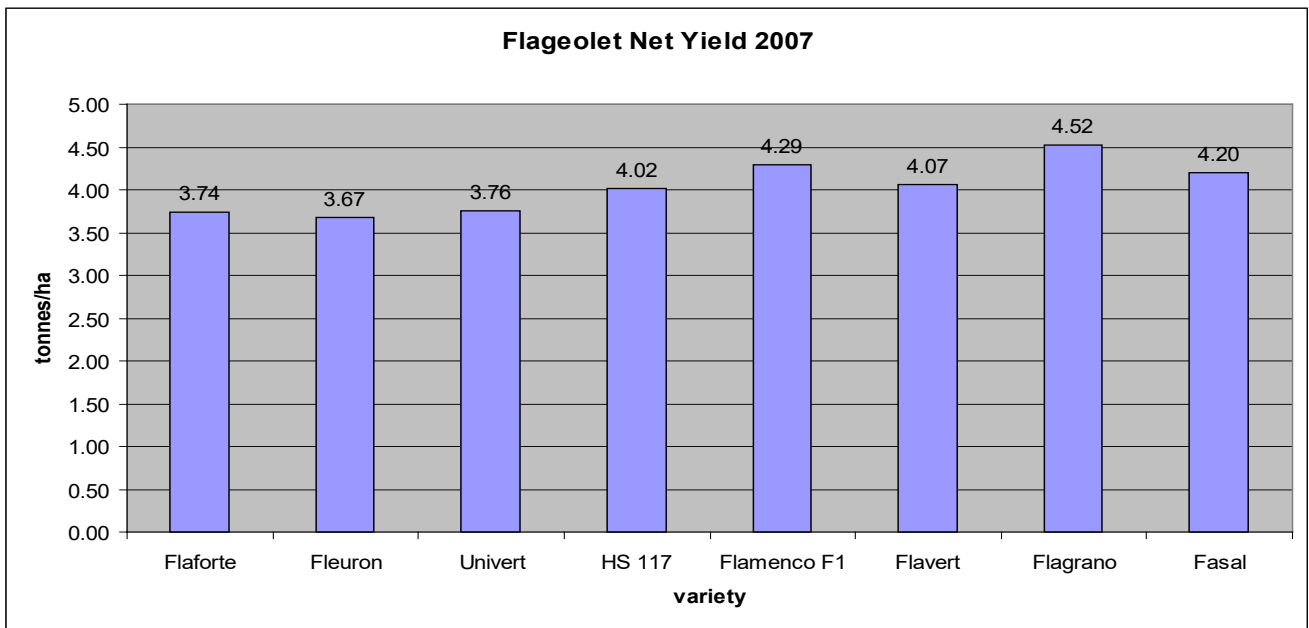


Table - 6 Marketable yield



Conclusions

Edamame

Edamame proved to be the most difficult to establish as a potential commercial proposition. The crop was grown successfully, however harvesting is more challenging. A further limiting factor is the lack of UK approved pesticides for this crop.

The crop can be harvested by green bean harvesters at the pod stage, but then the challenge is to remove the beans from the pod. In the Far East podding machinery is available but not in the UK.

At the moment no one is developing this crop in the UK, so access to a podding machine is not available to us.

In 2008 we shall be investigating further the potential of a commercial pea viner being used to harvest the crop.

Several of the varieties tested yielded well at the pod and at the shelled stage. Both the pod and the shelled products have a market and there appears to be potential for this value added product.

At this moment in time there is a new and small but increasing market in frozen Edamame, which is difficult to put a value on.

Further trial work to establish the correct plant densities and also the viable harvest stage between product quality and maximum yields is planned for 2008.

Flageolet

Flageolet proved to be relatively easy to produce at all stages of harvest.

The crop was harvested at both green and dry stage. The yields are commercially viable at both these growth stages.

There is a good range of varieties available for processing fresh this would be a new concept for the UK, how ever the French do it quite successfully.

There is large potential import market of dried Flageolet and trials indicate that this can be home produced.

Further trial work to ascertain optimum sowing times and plant densities for a UK Flageolet crop is planned for 2008.

APPENDIX 1

KEY TO SOURCE OF VARIETIES

<u>VARIETY</u>	<u>NAME & ADDRESS</u>	<u>COUNTRY</u>
<u>All Edamame varieties</u>	Pro-Veg Seeds, 6 Shingay Lane, Cambridge CB2 4SS	UK
<u>Flageolet varieties</u>		
Flaforte Flamenco	Pop Vriend Seeds BV, Middenweg 52 PO Box 5 1619 ZG Andijk	Netherlands
Fleuron HS 117 Flagrano	Holland-Select / Pro-Veg Seeds PO Box 27 1619 ZG Andijk	Netherlands
Univert Flavert Fasal	Nickerson-Zwaan BV PO Box 28 4920 AA Made	Netherlands