

## BREEDING EARLY-MATURING PROTEIN PEAS

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Finland is perhaps the northernmost country where field peas are cultivated. Our climatic conditions are characterized by short summers with long days. Daily temperatures drop rapidly in August-September, accompanied by increasing precipitation.

New well-adapted pea lines, however, grow well under these conditions. Seed yields can reach 7,000 kg/ha on a plot basis (Table 1). The mean yield is also high, about 4,500 kg/ha in trials and 3,000 kg/ha on a farm scale. Depending mainly on seed yield, protein yields can also rise to a high level. Considerable year-to-year variability occurs in both characters. The earliest commercial varieties reach maturity in 93-95 days on average. All present varieties are low- or semi-high-stemmed (50-80 cm).

The breeding of afila peas was started at the Hankkija Plant Breeding Institute in 1970. The gene was used to improve lodging resistance. At first, Usatyj-5 was used as a source of af. Later many John Innes varieties were included in crosses to transfer af and st genes into the material. At present, breeding is aimed at combining afila with early maturity, semi-high stem, small seed size, and as high a protein content and protein yield as possible.

Under Finnish conditions the crude protein content tends to remain low. This is a special problem in early afila lines. Protein content is negatively correlated with seed yield (Table 2) but protein yield is partly determined by protein content. To obtain higher protein yields, it is profitable to select in favor of higher protein content. Comparing normal Leaf type With afila alone and with afaf\_stst, decreased leaf area was associated with lower protein content. A highly positive correlation was found between protein content and flowering period, growing time, and stem height. However, late and tall varieties are totally unadapted to our climate. They are usually badly lodged when mature, accounting for the positive correlation between lodging and protein content.

Protein content is a clear character of variety. Differences in protein content among varieties persist to some degree from environment to environment, for example, from one year to another (Table 3). There are no exceptions to this when observing pure-lines at different breeding stages. These results are based on crop, not on single plants. Despite large year-to-year differences in protein level, the effect of a variety can be easily distinguished, making selection possible.

Significant differences were observed in protein content between crosses. To illustrate, some of the best and some of the most inferior cross combinations are presented in Table A. From certain crosses it is easy to select lines with a high protein content, whereas it is virtually hopeless in other crosses. Certain varieties also tend to give high- or low-protein progeny. The range of the protein content for single lines (Table 4) was high, in part reflecting environmental variation.

New afila pea varieties have been released from the program.

'Hankkijan Tammi' (Simo/Usatyj-5, 1984) is a relatively late small blue variety for both protein production and human consumption. 'Pika' (Procco/Hankkijan Tammi, 1986) is an early small blue variety for the same purposes. 'Helka' and 'Panu' are small blue protein'peas, released in 1986. Helka (Procco/Hja 51221) is medium early; Panu (Procco/Hankkijan Tammi) very early.

Table 1. Statistical data of varietal phenotypic characters. Main trials 1979-85; 388 observations from 8 m<sup>2</sup> plots with 2 replications.

Character	Mean	SD	Range
Seed yield (kg/ha)	4506	977	2110-7450
Protein yield (kg/ha)	989	241	410-1841
Flowering period (days)	22.6	9.7	5.0- 51.0
Growing time (days)	100.7	7.1	85.0-122.0
Stem height (cm)	78.6	23.6	31.0-167.0
Lodging (%)	45.8	25.5	0.0-100.0
Crude protein (%)	22.1	3.1	16.0- 29.3

Table 2. Phenotypic correlations between crude protein content and other varietal characters. Main trials 1979-1985; 388 observations.

Character	r
Seed yield	-0.19**
Protein yield	0.41***
Leal type	-0.39***
Flowering period	0.28**
Growing time	0.28**
Stem height	0.34***
Lodging	0.47***

Table 3. Correlations between crude protein content of varieties in successive years (Anttila exp. farm).

Trial and year	N	r
Main trial 1982 v. main trial	21	0.80***
Main trial 1983 v. main trial 1983	13	0.68*
Main trial 1984 v. main trial 1984	31	0.51**
Main trial 1985 v. main trial 1985	28	0.67***
Preliminary trial 1983 v. prel <sup>1986</sup>	56	0.60***
Preliminary trial 1984 v. prel. trial	51	0.65***
Line rows 1984 v. single plots. trial 1984 1985 1985	211	0.41***

Table 4. Crude protein content of different crosses from line rows in 1984.

Cross	n	Protein		
		x %	s	t
Frimas x Hankki jan Tammi	11	24.35	1.33	5.83***
L 1837 x Hja 51237	5	23.74	1.03	3.74*
Filby x Vreta	10	23.54	0.89	
Filby x Sv IJ 09901	20	22.96	1.23	3.45**
J.I. 758 x Hankkijan Tammi	24	22.92	0.74	5.97***
Omskij x Sv U 09901	15	22.90	1.15	2.96*
J.I. 502 x Hankkijan Tammi	24	22.73	0.99	3.53**
Mean for all lines	533	21.96	1.33	
Barton x Hankki jan Heikka	11	19.62	0.89	8.91***
Range, single lines		18.0-27.6		

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