GENETICAL STUDIES OF THE PISUM SATIVUM ROOT SYSTEM

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Very little is known about the genetics of the pea root in general or of the variability of roots of different pheno-/genotypes and the relations to seed yield components.

Jean (2), in his early work on the heritability of root morphology in peas, concluded: "The evidence, then, suggests strongly that hereditary genes accompanying those that determine height are the causative factors that determine root penetration in the case of peas, and not the physiological demands alone of the aboveground parts". It has been impossible to find other references of similar studies since then, but Veitenheimer and Gritton (4) have initiated a crossing program to study root genetics.

Zobel (5) used mutagenesis to study root systems of peas and indicated that selection for desired root variability should be successful either by utilizing genepools or through mutation breeding. Ali-Khan and Snoad (1) analyzed seven root and shoot characters of 30 pea genotypes and found considerable genetic variation in all characters studied.

At Pajbjergfonden a three-year project has been funded to investigate the root system of peas[1/]. Two experiments have yielded the following results:

A. The initial root growth of ten pea varieties was studied in the greenhouse in Jan/Feb 1984. Table 1 shows the varieties used, among which were white and colored flowered dry edible and garden peas. 'Filby' is a leafless pea and M131-81 and 'Wensum' are semi-leafless. M131-81 is a progeny from a cross 'Finale' x 'Filby'. The plants were grown in a sandy loam in PVC tubes (85 cm long, 10.5 cm diam), two plants per tube. Five replicates of each variety were harvested at four-day intervals, beginning six days after sowing. Total root length was measured using procedures described by Newman (3).

The results in Table 1 show highly significant differences in most characters. Of genetical interest are the varieties Finale, Filby, and M131-81, and I believe the significant similarities and differences between these three varieties give some indications of heritability.

Both from this experiment (Table 2) and from a screening of 400 varieties, we found good correlations between total root length and shoot length. If this correlation is caused primarily by physiological interactions between root and shoot there may be difficulty in breeding for larger roots.

B. Results from a screening of 39 pea genotypes (most old landraces) from Stig Blixt are shown in Table 3. Here, too, the root/shoot ratio shows a large variation among varieties.

To study in more detail the interaction between root/shoot, crosses have been made between very tall varieties with a large root system and commercial varieties with smaller roots. F2 will be grown this spring for a root test. In addition a crossing program has been set up using genotypes with well described genes for the shoot received from I. C. Murfet.

1. Ali-Khan, S. T. and B. Snoad. 1977. Ann. Appl. Biol. 85:131-136.
2. Jean, F. C. 1928. Botanical Gazette 86:318-329.
3. Newman, E. I. 1966. J. Appl. Ecol. 3:139-145.
4. Veitenheimer, E. E. and E. T. Gritton. 1984. PNL 16:73-74.
5. Zobel, R. 1974. PNL 6:58-59.

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ble 1. Eleven seed, root and shoot characters measure in ten pea varieties 30 days after sowing. Means of five replications. Means followed by different letters are significantly different at P=0.05. DW=dry weight.

Variety	DW of seed (mg)	Length Main root (mm)	Length Longest lateral (mm)	Length To last lateral (mm)	Total root length (cm/plant)	Root DW (mg)	Root nitrogen (%N of DW)	Length of shoot (mm)	Shoot DW (mg)	Shoot nitrogen (%N of DW)	Shoot carbon (%C of DW)
dil	304	623bc	189d	460cd	1029cd	73bcd	4.06abc	213b	195cd	5.05b	36.8a
ngreta	277	590b	155bcd	413bc	822bc	53b	4.28bcd	178ab	148bc	4.90b	37.8ab
eta	208	562b	158bcd	394bc	1054cd	83cd	4.39cd	388d	231d	4.13a	38.8ab
nale	348	692c	167bcd	433bcd	764b	59bc	4.21bcd	153a	154bc	5.59d	38.1ab
lby	283	585b	140bc	376bc	609ab	51b	3.85a	200ab	131ab	4.97b	37.9ab
131-81	282	691c	124ab	518d	787b	65bcd	3.85a	194ab	162bc	4.99b	35.7a
ma	167	590b	183cd	401bc	1106d	89d	4.03ab	376d	226d	4.04a	37.3a
erva	186	704c	184cd	514d	1186d	120e	4.01ab	439e	284e	4.09a	38.4ab
ssum	191	380a	90a	263a	406a	25a	4.47d	178ab	92a	5.41cd	38.9ab
w Perf.	201	529b	129ab	349ab	835bc	74bcd	4.19bcd	301c	228d	5.15bc	41.7b

Table **2.** Correlation coefficients among five root and shoot characters in seven successive harvests of ten pea varieties.

Correlation characters	Days after sowing 6	10	14	18	22	26	30
Root length - shoot length	0.78	0.38	-0.16	-0.16	0.13	0.32	0.15
Root DW - shoot DW	0.56	0.77	0.30	0.38	0.75	0.87	0.93
Root length-total root length			0.78	0.74	0.78	0.68	0.51
Shoot length-total root length			-0.20	-0.12	0.44	0.60	0.70
Root DW - total root length			0.84	0.87	0.90	0.89	0.89

Table 3. Ranges of root measurements of 39 pea genotypes from S. Blixt, compared to Bodil , the most grown dried pea in DK. Grown to beginning podfilling in soil in PVC-tubes.

	Min	Max	Bodil
Total root length			
cm/plant	1811	6090	3350
cm/cm^3 soil	0.65	2.56	1.29
DW (gr/tube)	0.27	2.82	1.00
DW (gr/plant)	0.11	0.95	0.36
Root/shoot ratio (DW basis)	0.12	0.41	0.24