Floral mutants: Allele designations at the *Lst* and the Aloci and the mapping of *Sypl*

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Pea flowers, like most zygomorphic flowers, possess a prominent corolla with three petal types, which are arranged along a dorsoventral (DV) axis. In order to study the genetic mechanism of floral zygomorphy in pea, screening for floral mutation was carried out on material generated in two mutagenesis programs at the John Innes Centre, INRA Versailles Centre and SIPPE. Several floral mutants affecting the development of DV asymmetry were recovered and two mutants displaying deficiency in the development of organ internal (IN) asymmetry were isolated.

A mutation at the *LOBEDSTANDARD1(Lstl)* (1) locus gives rise to the abnormal shape in the dorsal petals. *lstl-1* (registered as JI 3021) was a spontaneous event in JI 321 found in 1985 (1). *lstl-2* (FN 3046/67) and *lstl-3* (FN 3194/1343) were isolated in a fast neutron mutagenesis population of JI 2822 in 2006 and found to be allelic in crosses to JI 3021. The mutation at the *KEELED WINGS* (K) locus (2) is a classic marker line for genetic analysis. Two further lines were identified in the germplasm collection as having the same phenotype were found to be allelic in crosses to JI 73 which carries the same mutation as JI 17. *k-2* (JI 3260) arose by x-ray mutagenesis, and k-3 (JI 3261) was derived from fast neutron mutagenesis in JI 116 and JI 2296, respectively.

Table 1. Monohybrid segregation for the gene symmetrical petals *(sypl)* in a single F2 population.

Cross	Gene	Dom	Rec	Total	Chi square
PDL099 x JI 992	***sy*^{P1}**	**524**	**170**	**694**	**0.094**

During mutant screens, mutants bearing petals with altered IN asymmetry were identified and found to be allelic. The gene symbol *Sypl* (symmetrical petals) was proposed. Mutants *sypl-l* (PDL099) and *sypl-2* (FN 3443/2317) (3) were derived from EMS and fast neutron mutagenesis in Terese and JI 2822 respectively. In sy*pl-l,* nearly all petals are bilaterally symmetrical but maintain their DV identities. *sypl-2,* a weaker allele, has a highly variable effect on IN asymmetry of the lateral but not the ventral petals. In an effort to map the *sypl* locus, *sypl-l* was crossed with JI 992. A single F2 population of 694 plants were sown in greenhouse of which 170 were of mutant phenotype with symmetrical petals (Table 1) which demonstrated that *sypl* behaves as a single recessive gene. Using the mapping population, the *sypl* locus has been located between gene-based marker GbSTS1 and LegJ in linkage group II of pea (Fig.1) (4) and the gene-based dCAPS marker Puttip which co-segregated with *syp1* with no recombinants detected. Allele designations of all the lines described are represented in Table 2. All germplasm lines referred to in this article are available from the John Innes Pisum Collection and are detailed in the Pisum gene list (5).

Fig. 1 Linkage map showing the location of sypl.

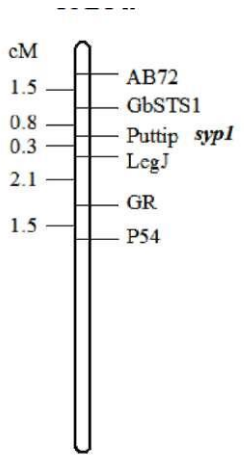

Table 2. Allele designations for *Lstl, K* and *Sypl* mutants.

Line	Allele	Status	Mutation agent	JI acc. no.
Lstl **lobed standard**				
JI 321 (Alaska)	*Lstl*	Wild type		JI 321
JI 3021	*lstl-1*	Type	spontaneous	JI 3021
FN 3046/67	*lstl-2*	Type	FN	JI 3518
FN 3194/1343	*lstl-3*	Type	FN	JI 3519
K **keeled wings**				
WL 232	*k-1*	Type	spontaneous	JI 17
WL 5240	*k-2*	Type		JI 3260
Wt16036	*k-3*	Type	150rNf/2h	JI 3161
FN 3082/907	*k-4*	Type	FN	JI 3517
Sypl **symmetrical petals**				
PDL099	*sypl-1*	Type	EMS	JI 3515
FN 3443/2317	*sypl-2*	Type	FN	JI 3516

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5. Pisum gene list http://www.jic.ac.uk/GERMPLAS/pisum/Zgc4g.htm