Gibberellins and seed development in *Pisum*

by

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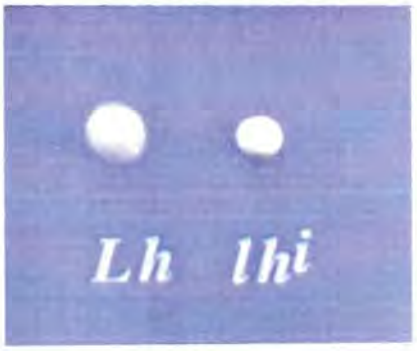

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Declaration

This thesis contains no material that has been accepted for the award of any other degree or diploma in any university and contains no copy or paraphrase of material previously published or written by another person, except where due reference is made in the text.

S. M. Swain

Abstract

Gibberellins and Seed Development in *Pisum*

The *lh*^{i} and *ls* mutations have been used to investigate the role of the gibberellins (GAs) in seed development of the garden pea (*Pisum sativum* L.). These mutations were originally identified by their effects on internode elongation. Plants homozygous for *lh*^{i} or *ls* possess reduced levels of endogenous GA_1 in developing shoots, resulting in a dwarf phenotype compared with wild-type plants. The *Lh* locus has been shown to be linked to the *Le* locus at a distance of ca. 5cM. In conjunction with wild-type plants and other GA-deficient mutants, *lh*^{i}, *ls* and *le*^{5839} plants have been used to demonstrate a log-linear relationship between endogenous GA_1 levels and internode elongation, further supporting a role for GA_1 as the major native GA controlling internode elongation is this species. However, the *lh*^{i} mutation differs from other GA-deficient mutations, such as *lh*, since the response of *lh*^{i} plants to paclobutrazol (an inhibitor of GA-biosynthesis) is dramatically increased.

The *lh*^{i} and *ls* mutations also reduce endogenous GA levels in developing seeds. This has allowed the site of action of the *ls* mutation to be identified. Incubation of cell-free enzyme systems from developing wild-type and *ls* seeds suggests that *ls* plants possess reduced *ent*-kaurene synthetase A activity. The *lh*^{i} mutation also reduces endogenous GA_1 and GA_3 levels in young seeds (a few days after fertilization), while *ls* seeds possess similar GA_1 and GA_3 levels at this stage compared with wild-type seeds. Comparison of GA levels in *lh*^{i}*lh*^{i}, *lsls*, *Lsls* and wild-type seeds suggests that GA-biosynthesis may vary within different tissues (embryo, endosperm and testa) of developing seeds. Seeds homozygous for *lh*^{i} are more likely to abort during development, and weigh less at harvest, compared with wild-type seeds and seeds homozygous for *ls*. Altering the source/sink relations of developing *lh*^{i} plants, and ^{14}C-photoassimilate studies, both suggest that *lh*^{i} seeds possess reduced sink strength compared with wild-type seeds. Fertilizing *lh*^{i} plants with wild-type pollen produces seeds with normal GA levels and restores normal seed development. Culturing of *lh*^{i} embryos with GA_1 *in vitro* also increases embryo size. These results have been used to suggest that GA_1 and GA_3 play an important role early in pea seed development. By contrast, the high GA levels found in maturing wild-type seeds do not have a physiological role in seed development.

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