13. *In vitro* Culture of Legumes

M.R. Davey, V. Kumar and N. Hammatt

---

1. Introduction

The Leguminosae (Syn. Fabaceae, Papilionaceae, Caesalpinaceae, Mimosaceae) is one of the largest and most widespread families of flowering plants, with representatives in most habitats. The plants range from small herbs to large trees. The economic importance of this family derives from the large number of legumes exploited for human consumption, being used in several forms as immature seed, dry grain, roasted grain, in flour production, as condiments and as fermented products. The high level of lysine makes grain legumes a good supplement for cereals, which are deficient in this amino acid. In addition to their protein content, the seeds of many grain legumes are also rich in oils (e.g., seeds of *Glycine max* contain 40% protein and 20% oil). Owing to their high protein content, legumes are important in the production of livestock and fish food, while forage legumes such as species of *Medicago*, *Lotus* and *Trifolium* are used as fodder, hay and silage. Legumes are an excellent source of vitamins, thiamine and niacin, as well as minerals, calcium and iron. They also contain about 60% carbohydrates,
mainly as starch. Many legumes (e.g., species of *Acacia, Albizia, Dalbergia, Leucaena* and *Prosopsis*) are used as sources of timber and fuel, particularly in tropical regions, while others are grown as ornamentals (e.g., *Lathyrus odoratus* and species of *Clianthus, Laburnum* and *Lupinus*). The oils of grain legumes are employed extensively for industrial purposes. A characteristic feature of the majority of legumes is their ability to develop root nodules in response to infection by soil bacteria of the genus *Rhizobium*. The atmospheric nitrogen fixed within such structures enables the host plants to grow on nitrate-deficient soils and, ultimately, to improve soil fertility.

The ability to culture plant cells and tissues has provided the opportunity to micropropagate specific, and often elite, plant clones by the stimulation of axillary buds and, latterly, through the production of somatic embryos. Furthermore, manipulation of culture conditions has facilitated the adventitious regeneration of plants from whole organs, explants, callus and isolated protoplasts. Advances achieved during the 1970s and 1980s in the application of *in vitro* techniques to the genetic manipulation of members of plant families, such as the Solanaceae, stimulated interest in extending such procedures to other economically important crop plants, including legumes. This article summarises advances made in the culture of legumes, and suggests ways in which some of these techniques may be applied to legume improvement.

## 2. Tissue Culture of Legumes

### 2.1. Culture of Excised Meristems and Micropropagation

Many herbaceous and woody plants can be propagated rapidly *in vitro* through the stimulation of axillary branching, followed by rooting of the resulting microcuttings. The micropropagation of legumes was first reported by Kartha and Gamborg (1978) who cultured excised meristems of pea (0.2–0.3 mm in diameter) on a B5-based medium supplemented with the growth regulators 6-benzylaminopurine (BAP) and α-naphthaleneacetic acid (NAA). Such micropropagated shoots also provided a source of axillary meristems for further multiplication. Several herbaceous legumes have now been micropropagated, such as *Trifolium* species (Williams et al., 1990), but this approach has only just begun to be investigated for leguminous trees such as *Acacia* (Mittal et al., 1989).

### 2.2. Embryo Culture

The culture of excised embryos was one of the earliest techniques devised for legumes. Indeed, methods have been developed to culture embryos after their excision from the pods, at all stages of development from globular