

# White Clover Molecular Genetics

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- I. Introduction
- II. Transgenic Approaches to White Clover Improvement
  - A. Transgenic Plants
    - 1. Tissue Culture
    - 2. *Agrobacterium*-mediated Transformation
    - 3. Transgene Expression
    - 4. Transgene Inheritance
  - B. Transgenic Breeding Strategies
    - 1. Modified Synthetics with Progeny Testing
    - 2. Backcrossing into Cultivars
    - 3. Direct Transformation of Inbred Lines
  - C. Genetic Engineering for Resistance to Viral Diseases
    - 1. Coat Protein-mediated Resistance
    - 2. Resistance Using Mutated Viral Genes
    - 3. Gene Silencing and Virus Resistance
  - D. Transgenic Plants for Pest Resistance
  - E. Potential for Improved Nutritive Value
- III. Marker-Assisted Selection
  - A. Map-Based Selection
  - B. Genetic Diversity and Parental Selection
- IV. Conclusions
- Literature Cited

## I. INTRODUCTION

White clover (*Trifolium repens* L.), a perennial legume species, is an important component of many temperate grazed animal production systems. The species is adapted to regions from the Arctic Circle to the subtropics, and from sea-level to altitudes of 6000 m in the Himalaya mountains (Williams 1987a). White clover's indigenous range covers all of Europe, western central Asia and areas of North Africa, and it has become naturalized in China, Korea, Japan, Australasia, North, Central and South America (Gillet 1985; Taylor 1985; Williams 1987a). As a crop, white clover is grown in association with temperate grasses to provide a low-cost, high-protein feed source for grazing livestock. White clover is particularly valued for its capacity to fix atmospheric nitrogen in grazed swards (Boller and Nosberger 1987; Crush 1987), and much of this nitrogen becomes available to support the growth of the companion grasses. White clover has higher nutritive value than the associated grasses with which it is grown, due to lower levels of structural carbohydrate (Ulyatt 1981), higher levels of crude protein (Minson 1990), and a faster rate of passage through the rumen of grazing animals (Rattray and Joyce 1974). In addition, the voluntary daily intake rates (kg dry matter/animal) of white clover by grazing ruminants are higher than for grasses due to a lower length-to-width ratio of fibers in the foliage and smaller quantities of cell wall components (Rogers et al. 1982; Minson 1990).

The seasonal growth patterns of white clover and associated forage grasses are complementary, such that when grown together they provide a more consistent feed supply than if grown separately. Growth of white clover occurs later in summer and fall when grass production is reduced. The stoloniferous growth form and phenotypic plasticity of white clover also make it a preferred companion legume in grass swards and enable it to withstand severe defoliation.

White clover ( $2n=4x=32$ ) is predominantly an obligate outcrossing species with disomic inheritance and has a gametophytic self-incompatibility system based on multiple alleles at the S locus (Williams 1987b). The outcrossing nature of white clover means that natural populations are a heterogeneous mixture of highly heterozygous individuals. This has resulted in high levels of genetic variation both within and between populations, and it is this genetic variability that has been critical to the success of white clover over such a wide environmental range. White clover can hybridize with three species: *Trifolium uniflorum* L. ( $2n=4x=32$ ), *T. nigrescens* Viv. ( $2n=2x=16$ ) and *T. occidentale* Coombe ( $2n=4x=32$ ), and with greater difficulty with at least three other *Trifolium* species (*T. ambiguum*, *T. hybridum*, L. and *T. isthmo-*