
# Understanding Tetraploid Technology

# What is a tetraploid?

**We look at the technology of tetraploid perennial ryegrasses, which are highly valued for their fast establishment, cool temperature recovery, high root mass and greater stress tolerance**

By: Jayne Leyland

**Ploidy**

Ploidy refers to the number of complete sets of chromosomes within the nucleus of each plant cell. Polyploid plants contain more than two sets of chromosomes within each cell. Chromosomes are thread-like structures arranged in linear pairs. Each chromosome is made of protein and a single molecule of hereditary DNA (deoxyribonucleic acid) wrapped around the protein. Polyploidy is naturally occurring in many wild and cultivated plant species, including grasses like fine fescues, which can be hexaploid or octaploid.

Polyploidy can also be induced in plants through the application of a natural alkaloid plant hormone colchicine, derived from Colchicum autumnale (Autumn Crocus).

> "Superior winter wear and robust re-growth helps keep surfaces in play though the winter high-pressure period"

Colchicine acts as a mitosis inhibitor, resulting in chromosome doubling within each cell, thus diploid (2n) becomes tetraploid (4n).

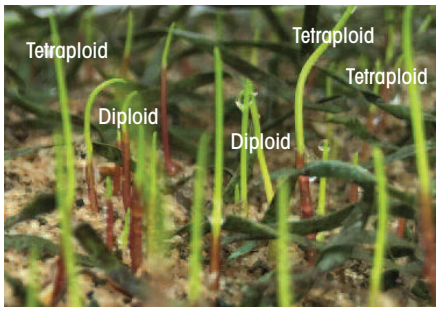
**Induced polyploidy**

Perennial ryegrasses bred and developed for amenity use are historically diploid, having two paired sets of chromosomes within each cell. Tetra is the Greek translation for four, meaning tetraploids have four paired sets within each cell, a physiological characteristic that delivers such exceptional benefits to the plant.

Mitosis is a part of the cell cycle in which chromosomes in the cell nucleus are separated into two identical sets, each paired set ending up inside an identical diploid cell. Microtubules are microscopic structures that help cells maintain their shape and assist in forming the cell spindle which, during cell division, divides the chromosomes into pairs. In the creation of a tetraploid, the hormone disrupts the microtubules, preventing formation of the spindle that divides the genetic material.

The process of mitotic polyploidy results in cell enlargement, doubling the sets of chromosomes (four pairs) in each new daughter cell.

*Chromosome counting in the laboratory*




*Tetraploid seedlings emerge faster than diploids*

**Energised**

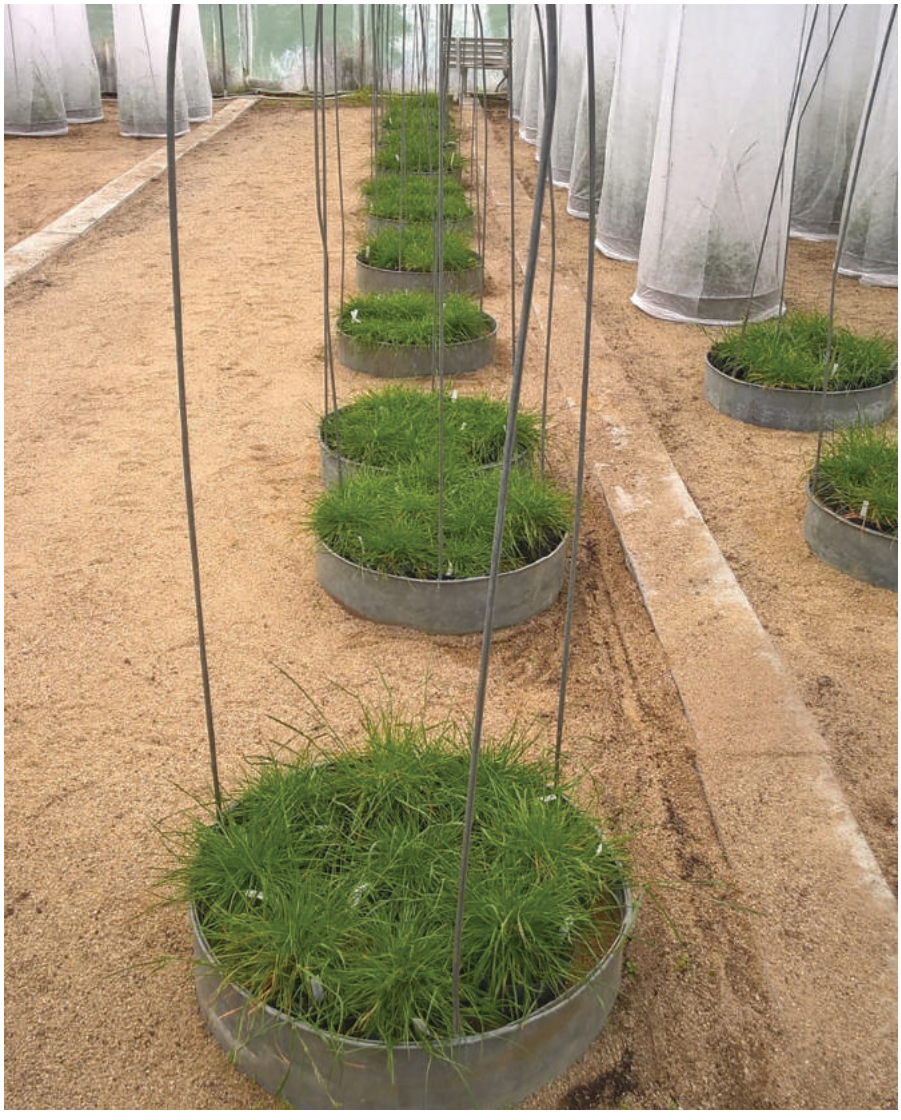
Chloroplast comes from the Greek translation chloros (green) and phyllon (leaf). Each tetraploid cell contains double the chloroplast of a diploid. The doubling of chromosomes and in particular chloroplast produces robust plants with greater stress tolerance. Thylakoids inside the chloroplast contain the light-harvesting complex, including the chlorophyll green pigments essential to photosynthesis, absorbing sunlight in energy-rich molecules. Photosynthesis converts the light energy into chemical energy, which is stored as carbohydrate and synthesised with water and carbon dioxide gas to produce energy for the plant. Oxygen is released as a waste product. The increased cellular chloroplast benefits the plant by boosting chlorophyll production for energy absorption and processing. The outcome is a high energy, robust, hardwearing, healthier plant with improved stress tolerance and recovery capability, even in cooler temperatures.

**Development**

The first stage when creating a new tetraploid cultivar is different to the beginning of a new diploid. In place of the more usual clonal and poly-cross breeding, an amenity diploid cultivar with the desired characteristics is selected for its characteristics and treated with the hormone. The treatment is applied to just a few grammes of seed in their initial stages of germination prior to emergence.

Seed is then multiplied in isolation to produce sufficient seed for further investigation. As with all new cultivars, the resultant progeny must conform to DUS protocols, that being distinct, uniform and stable, in order to achieve plant breeders' variety rights and registration, a pre-condition for seed certification. Initially, young plants are grown under glass for observation, and leaves and shoots have chromosome counts taken.

It may take a second or third generation of the new tetraploid offspring to produce both stability and viability for seed production. Several plants from the same parent are multiplied together in isolation. The resultant seed is harvested and used for field testing in the same way as diploids. Seeds are larger and high energy, around 500 seeds per gramme compared with 650-700 per gramme for sports diploids and up to 800 seeds per gramme for ultra-dwarf super fine ryegrass. It's at this stage where potential new cultivars are pushed to the limit and vital characteristics such as growth habit, wear, disease and drought tolerance, mowing height and visual merit are assessed. Only one or two will make it through this rigorous process from the many thousands at the beginning of the process.



*Seed being grown in isolation, under cover*

**Proven performance**

Tetraploid perennial ryegrass provides a host of invaluable characteristics not found in diploids. High energy seed and growth in cooler conditions from 4°C makes blends containing tetraploids such as R140 and R25 CRT perfect for transitional autumn overseeding and repairs. Superior winter wear and robust re-growth helps keep surfaces in play though the winter high-pressure period. Outcomes from the Rigby Taylor Sports Wear Trial at STRI concluded the balanced blend of tetraploid with top performing diploid perennial ryegrasses in R140 delivered superior winter wear performance compared with traditional diploid blends and mixtures.

Tetraploids' high root mass also delivers greater drought tolerance and stability. Fast establishment is of particular benefit when renovation windows are short.

Doubling of the chloroplast enables tetraploids to harness as much light as possible, a useful characteristic when light levels are low. A shade and wear trial at Les Alleuds Research Station shows how the latest tetraploid cultivars deliver great wear performance in reduced light levels of 60% PAR (photosynthetic active radiation).

Selecting cultivars with high disease tolerance is also important; official testing for the GEVES Turfgrass List highlights excellent tolerance of tetraploid cultivars to Microdochium Patch, Red Thread and Rust diseases

*Light trials at the Les Alleuds Research Station*

**The future?**

Although a relatively recent introduction to the amenity market, tetraploid mixtures and blends are fast becoming the number one choice for renovation and repair of natural and hybrid grass surfaces. Blended with diploid ryegrasses or mixed with fescues, they are reliable performers that always deliver – in a whole host of environments including football and cricket pitches, racecourses (flats and jumps) and golf courses.

*Jayne Leyland is grass seed & line marketing product manager at Rigby Taylor, www.rigbytaylor.com* ●

*STRI Sports Wear Trials concluded that the balanced blend of tetraploid with top-performing diploid perennial ryegrasses delivered superior winter wear performance compared with traditional diploid blends and mixtures*