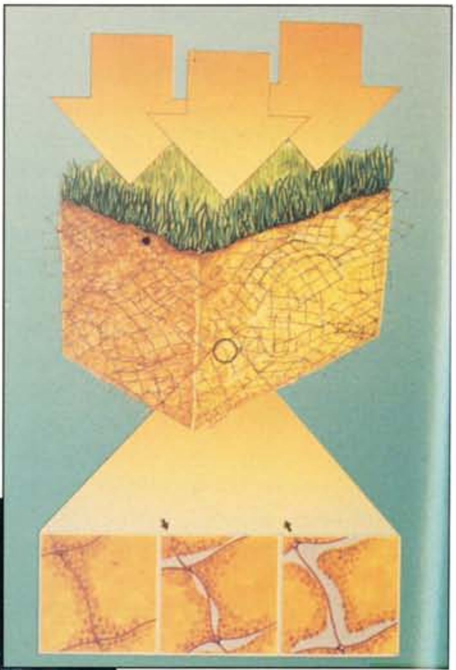
Self-Cultivation –

An Alternative to Mechanical Aeration?



Rootzone section demonstrating the effect of traffic pressure. Inserts show, from left, rest state, compression and element flexing, release of pressure and element springing back to create the soil void and maintain the micro-aeration action.

Rugby match in progress at Melbourne Cricket Grounds.

By Stephen Guise

Establishment and maintenance of a thriving turf field for athletic activity requires the proper environment for optimum grass growth. Mechanical aeration has for years been a vital part of the maintenance regime implemented to stimulate development of deep, healthy roots; to increase pore space for water, air and nutrient movement through the soil profile; and to improve percolation rates.

Turf professionals have considered the time and labor that could be saved if these same benefits could be achieved by the addition of a long-lasting material to the soil profile, rather than through repeated multiple aerations each year. Various combinations of many types of materials with differing properties and in a multitude of sizes have been tested within the soil profile to attain the desired conditions with less need for aeration.

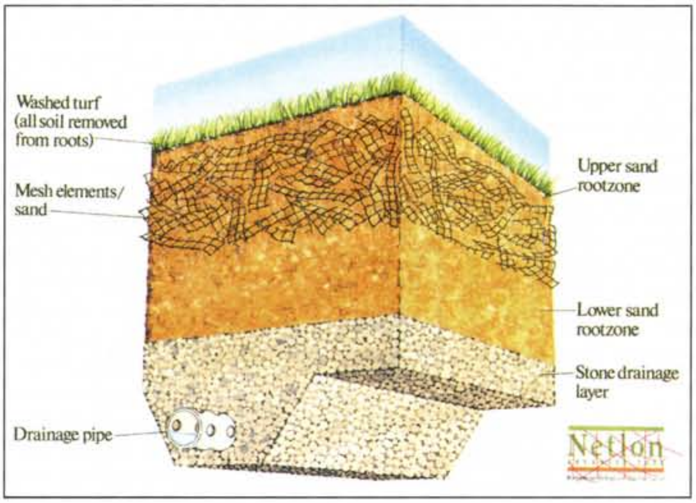
Researchers at Texas A & M University conducted a series of tests on the stabilization of high-sand rootzones by incorporating interlocked, randomly-oriented polypropylene mesh elements. The improved health of the turfgrass in those plots with the mesh elements in the rootzone was noted. To further examine the nature of the turf development and to assess the reasons for differing turf reactions, additional testing was conducted. Researchers undertook an objective assessment of the health of the turf in test plots with and without the mesh elements, and an assessment of the causes of the health through microscopic examination of the rootzone matrix.

Viewed through the microscope, undisturbed sections of the rootzone demonstrated the existence of minute voids associated with the mesh elements, which appeared to facilitate good aeration at the microscopic level. A hypothesis for the formation of these voids is that whenever the soil is subjected to traffic – from people or vehicles – the mesh element matrix may well be flexing slightly under the loads and causing a micro-cultivation effect in the rootzone.

Research had already fully-documented superior water infiltration rates, healthy deep rooting and an absence of "black layer" in rootzones containing mesh elements. Studies continued to assess whether the mesh elements might also be associated with the presence of these voids and micro-aeration of the soil.

Turfgrass Health

To conduct the testing, mesh elements had been mixed into a carefully-graded, high-sand rootzone mix to achieve a maximum dispersal through the rootzone when it was laid. The plots were planted with vegetative sprigs of Tifway bermudagrass which were broadcast at a rate of 14 bushels per 1,000 square feet. This was followed with a light topdressing and fertilization. The measurements of turf growth and health were made over eight years after the plots were established. Control plots - without the inclusion of the mesh elements - were established and maintained in exactly the same manner as the mesh-containing plots.



Profile of rootzone containing Netlon.

Turfgrass health was measured in terms of the depth of the turf canopy and of the root depth within core samples taken from plots - both those with mesh inclusion in the rootzone and those control plots without mesh inclusion. Test comparisons included three 4-inch diameter by 8 1/2-inch-long cores,

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from three replications of the two plot treatments.

As can be seen from Table 1, the measurements showed a striking difference between plots in terms of the depth of the turf canopy and thatch; the depth of the roots (which actually exceeded the depth of the core sample in the mesh-containing plots); and the viability of the roots (measured as the percentage of white, full, healthy roots in the core as opposed to black, spindly roots, which were especially apparent in the control plots below a depth of 3 inches).

Rootzone Studies

Micromorphology studies were conducted by Michael DePew, L. Wilding and James B. Beard to evaluate the physical and structural properties of paired rootzones — those with and without mesh inclusion — by several techniques, including thin soil-section micrographs.

Soil samples were collected in pairs from the no-mesh and mesh-inclusion turf plots. These cores were frozen in liquid nitrogen, cut to size and freeze-dried. The thin sections of the test-plot cores were then impregnated with epoxy, mounted, cut, ground and polished for the development of micrographs.

Using a cross-polarized light microscope, voids were revealed around the mesh-element strands in the sections from the mesh plots. No such voids were present in the no-mesh plots.

Aeration Through Micro-Cultivation

It is hypothesized that, when the pressure from traffic (e.g. athletes, other sports-related personnel, equipment, pedestrians, animals or vehicle traffic) is transmitted through the rootzone from the surface, the pressure causes the mesh to flex. When the small pieces of mesh (approximately 4 inches by 2 inches) are incorporated throughout the soil profile at a density great enough so that they become randomly interlocked, the pressure and the subsequent flexing also are transmitted between the pieces of mesh, thus helping to spread the area of load. As the load pressure is removed, the inherent stiffness of the mesh material causes it to spring back to its original shape. This movement can thus create the voids observed throughout the soil profile.

TABLE 1

A comparison of no-mesh versus a 4.2 pounds per cubic yard mesh density on Tifway bermudagrass grass after four years.

Plant Response	Rootzone Treatment no-mesh	Rootzone Treatment mesh inclusion
Depth of turf canopy and thatch (inches)	1.6	2.5
Root depth (inches)	5.9	8.5 plus
Root viability (%)	14	100

The conclusion is that grass plots with mesh elements included produced grass with a much greater production of vegetative matter, a greater canopy height, and a deeper, fully-healthy root system.

This micro-cultivation action could therefore be causing micro-aeration around the roots and contributing significantly to the very-evident root health. Having a permanent micro-aeration action incorporated within the rootzone in this fashion could greatly reduce or eliminate long-term needs for aeration on high-use sports turfs. This hypothesis is consistent with the superior level of turf growth and health of the mesh-containing trial plots over the no-mesh plots as observed over an eight-year testing period.

Clay Bridging and Black Layer

Scanning the root core sections with an electron microscope revealed the further interaction of the mesh with soil particles. In the sections from the no-mesh control plots, finely-textured clay could be seen extending continuously and bridging between the sand particles. In addition, iron oxide had accumulated in these layers, which corresponded to the observed black layer depth of between 3 3/4 inches and 5 inches below the soil surface on the no-mesh plots.

In contrast, at the same soil depth, sections from plots with mesh showed finely-textured clay coating the sand particles without bridging between them.

In the no-mesh control plots, this clay-bridged sand contributed to reduced soil-water infiltration and percolation, followed by the development of a micro-waterlogged zone above the clay-bridged zone. This created an anaerobic condition which inhibited healthy root development. This is certainly one potential cause of black layer in sand rootzones.

The presence of voids, maintained by the micro-cultivation and micro-aeration of the mesh flexion as discussed above, would certainly assist in better water micro-percolation and the promotion of aerobic conditions favorable to vigorous root growth.

Use of mesh elements in athletic turf fields currently is being used with good success in the U.S. and overseas. Examples of such use include the Santa Anita Turf Racing Courses - where the "athletes" exert considerable force - the Melbourne Cricket Grounds in Melbourne, Australia, which is the world's largest sports field, and Murrayfield, the world-renowned home of the Scottish Rugby Union. ❑

Editor's Note: Stephen Guise is National Sales Manager and Consultant for Netlon Limited, Fullerton, CA, Treasurer of the national Sports Turf Managers Association, and a founding member of the Southern California Chapter of STMA. This article was adapted from the British publication "Groundsman," Volume 47 # 5, May 1994.