Climate Regulation & Oxygen Supply

Sustainability fact sheet
Benefits of golf courses series

The issues

- Earth's climate system has been affected by increasing concentrations of carbon dioxide (CO_2) from fossil fuel use and land use change.[1]
- CO_2 accumulates in the atmosphere and reflects solar radiation back to earth's surface leading to global warming through a process known as the 'greenhouse effect'.
- Climate change scenarios forecast future increases in average annual temperature of between 1°C and 5°C by the 2080's, combined with greater extremes of weather and rising sea levels.[2]
- In addition to the issue of a changing climate, growing global populations are placing increasing demands on scarcer resources. World population is projected to grow to a peak of 9.22 billion people in 2075.[3]

Golf course solutions

- There has been increasing interest in the capabilities of different ecosystems to remove carbon from the atmosphere.[4] 'Carbon sinks' (ecosystems which absorb more carbon than they release) offset CO_2 emissions, thereby improving atmospheric composition.[5]
- Carbon sequestration is the process of capturing and storing carbon in the form of soil organic matter (SOM). Approximately 58% of this is composed of soil organic carbon (SOC). Turfgrasses use CO_2, in the process of photosynthesis, to produce organic materials in the plant structure. Some of this captured carbon becomes stored in the soil as SOC over time.[6,7]
- Since turfgrass ecosystems are highly productive and are subjected to minimal soil disturbance after establishment, they may be making substantial contributions to the sequestration of atmospheric carbon on a global scale.[8]
- Studies have shown that putting greens can sequester 0.4 tonnes of carbon per acre, per year, for 30 years. Fairways can sequester 0.44 tonnes of carbon per acre per year for the first 20-25 years after establishment. After these periods of time, the rate of SOM accumulation gradually reaches equilibrium.[6]

To learn more about the benefits of sustainability and best practice visit www.randa.org/thegolfcourse

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- Perennial managed turfrgass systems, such as those found on golf courses, sequester the greatest amount of carbon which means roots can grow deeper and soak up even more carbon.[7]
- Leaving grass clippings on the ground to naturally decompose allows the largest amount of carbon to be accumulated.[7]
- Irrigated and fertilised turfgrasses act as a carbon sink, even assuming removal and bagging of the grass clippings after mowing.[7]
- Nitrogen fertilisation increases the accumulation of carbon in the soil.[7]
- The net per area carbon sequestration benefit is estimated to be approximately 0.86 Mg C/ha/yr for areas managed with ride-on mowers and 0.80 Mg C/ha/yr for areas managed with walk-behind mowers. The net benefit is approximately four times greater than the carbon emissions caused through mowing.[7]
- In conjunction with their ability to sequester atmospheric carbon, turfgrasses also provide evaporative cooling[2] and produce oxygen.[9]
- Maximum surface temperatures are highly dependent on the proportion of green land cover. Adding additional green cover, such as through turfgrass, could help to limit future temperature rises.[2]
- Preserving areas of existing green space and enhancing it where possible, is one possible adaptation strategy to rising temperatures.[2]
- A turfed area of 50' x 50' produces enough oxygen to meet the every day needs of a family of four and each acre of grass produces enough oxygen for 64 people a day.[9]
- A typical 18-hole golf course produces enough oxygen to support 4,000 to 7,000 people.[10]
- Turf is about three times more effective than trees are as a supplier of oxygen and its season to produce oxygen is also much longer than that of trees.[10]

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References

[1] - IPCC, 2007: Summary for Policymakers. In: Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [Solomon, S., D. Qin, M. Manning, Z. Chen, M. Marquis, K.B. Averyt, M.Tignor and H.L. Miller (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

[2] – Purakayastha, T.J., Huggins, D.R. and Smith, J.L. (2008) 'Carbon Sequestration in Native Prairie, Perennial Grass, No-Till, and Cultivated Palouse Silt Loam', *Soil Science Society of America Journal* **72**(2), March – April 2008: pp. 534 – 540

[3] - United Nations, 'World Population to 2300', United Nations Department of Economic and Social Affairs/Population Division, http://www.unruhturf.com/pdf/2Did%20You%20Know-Trees%20%26%20Grass%20Both%20Clean%20the%20Ari.pdf (accessed 15/09/11)

[4] – Bandaranayake, W., Qian, Y.L., Parton, W.J., Ojima, D.S. and Follett, R.F. (2003) 'Estimation of Soil Organic Carbon Changes in Turfgrass Systems Using the CENTURY Model', *Agronomy Journal* **95**, pp. 558-563

[5] – Carson, T. (2003) 'Are golf courses carbon sinks?', *Golf Course Management*, September 2003: p. 28

[6] – Qian, Y. (2003) 'Can Turfgrass Sequester Atmospheric Carbon? Assessment Using Long-Term Soil Testing Data' *TPI Turf News*, March/April 2003: p. 23

[7] – Sahu, R. 'Technical Assessment of the Carbon Sequestration Potential of Managed Turfgrass in the United States', Research Report, http://www.opei.org/dotAsset/15570.pdf (accessed 15/09/11)

[8] – Qian, Y. and Follett, R.F. (2002) 'Assessing Soil Carbon Sequestration in Turfgrass Systems Using Long-Term Soil Testing Data', *Agronomy Journal* **94**, pp. 930-935

[9] – The Lawn Institute, AIR, Oxygen and Turfgrass, http://www.thelawninstitute.org/environment/?t=3150&st=5039&c=185514 (accessed 15/09/11)

[10] – Addink, P. 'DID YOU KNOW: Trees and Grass Both Clean the Air – Turf Resource Center', Turf Resource Center, http://www.unruhturf.com/pdf/2Did%20You%20Know-Trees%20%26%20Grass%20Both%20Clean%20the%20Ari.pdf (accessed 15/09/11)