Shelterbelt agriculture uses trees to protect soil and water resources

by

Henry Kock

University of Guelph Arboretum

Our forefathers arrived centuries ago and cleared land for agriculture as has been done since the first seeds were planted. Now is the time to look back at what happens to the earth when trees are removed over large areas, trees that are the sheltering skin of this earth, that prevent the wind from drying the soil and blowing it away.

There are only two natural deserts in the world, the Atacoma desert in Northern Chile and the Carcross desert in the Yukon, which are rain shadow areas. All the other deserts are what is left of what were once grasslands and forested watercourses! Through all of the ages people have cleared for grazing, cut trees for fuel and building, and cleared land for crops - but never planted trees to protect the land. Only in the last century have trees been planted, and only rarely have sheltering windbreaks been left to keep the wind from drying out the earth.

Shelterbelts slow down the velocity of the wind and direct it up off of the land. It is imperative to understand the importance of slowing down the wind, as it has everything to do with water. This is a water planet and water is what moderates climate by its ability to hold heat.

Exposed land

Farmland that is exposed to wind at the surface loses water faster than if there was a cover crop or meadow or forest. When the wind removes soil moisture (dried-out soil is a familiar sight - cracks that you can fit your hand into) the land loses its heat holding capacity. This loss is increased by the use of tile drainage and ditches. As much water is engineered off of the land as possible without realizing that it is required for replenishing the ground water reservoirs. Without water's heat holding ability temperatures fluctuate to greater extremes; the land heats up more during the day, steaming off even more water, and cools off more rapidly at night, in creasing the risk of ground frost. Daytime activity is critical in that it the land heats up rapidly hot air updrafts become more pronounced, so much so that wind velocities in crease and soil particles can be noticed in the air. What is not usually noticed is that these strong updrafts draw in the low level clouds from the surrounding area. The result is violent storms associated with towering Cumulonimbus (thunderheads) which deliver no rain, or very heavy isolated down pours. This kind of rainfall nuns off (with soil) into the ditches instead of gently soaking into the soil to replenish dropping water tables. If the land is sheltered and ground cover is maintained with cover crops, then the hot updrafts are not as likely to occur. When the heat convections are reduced, a gentle soaking rain fall from widespread low level clouds replenishes the ground water It is now possible to see how the amount of rainfall does not determine soil moisture so much as the rate at which water returns to the soil, thereby replenishing or not the ground water reserves.

Winter losses

Winter is a long season with considerable amounts of precipitation, most of which blows off of the land if there are no hedge rows or shelter belts. During the winter, snow prevents soil from freezing, drying out, and blowing away. The heat of the earth melts a great deal of snow at ground level - slowly - gradually replenishing ground water instead of only filling the ditches and streams when thaw comes. With the use of hedges, snow can be trapped on higher ground so that the melt water is useable.

Trees die young

The evidence of a dropping water table can be seen in dead tree tops, trees that have not yet reached half their Ike expectancy. These trees draw water as it moves upward f rom the ground water reservoirs for three uses: first, to keep the cells full of water; second, for transpiration from leaves, twigs, and trunk to keep the plant cool (the air under a tree or at ground level in vegetation is always cooler); third, for the chemical reaction known as photosynthesis. This chemical reaction is so fundamental to life and so simple. The water molecule is split and its hydrogen atoms are attached to carbon dioxide from the air to form simple carbon sugars. These are the energy source for all living organisms that do not get energy directly from the sun. The availability of water is essential to this reaction, and therefore, to life on this planet.

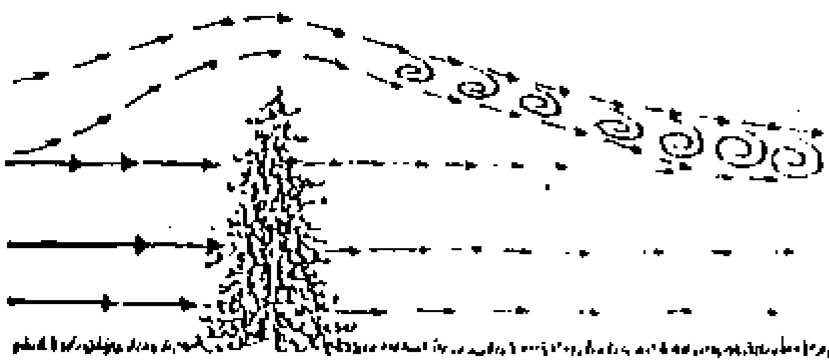
When a tree is stressed by drought all of the water that it can take up is needed for transpiration - to keep the plant cool. Consequently, there is little water available for photosynthesis. Without energy conversion from sunlight the tree can not feed itself well enough and the root system suffers directly, in turn leading to a downward spiral of reduced health and strength for the whole tree. This is true for any plant.

Imagine yourself as a soybean plant that has just germinated and produced the first set of true leaves. You are out in the middle of a large field. The sun rises and you think to yourself I am really going to grow a lot today, but by 9:30 the wind comes and it gets very hot. For the entire day you are pelted by grains of soil and bent over, flapping in the stiff wind. There is moisture in the soil, but most of what you take up is used to keep yourself from drying out. There will not be the growth that is possible and you will not yield what you have the potential to. This soybean is also weaker and more likely to suffer further from weed competition, or disease and insect damage. This is not an efficient crop system.

Best type of windbreak:

deflection with some permeability

The wind's effect is reduced, it's speed slowed. Protection for the land on the leeward side can reach up to 15 times the height of the wind-break.



Source: La Culture Ecologique, Yves Gagnon 1990

Yield increases

Now imagine yourself, the same soybean plant, growing in a field that is protected by windbreaks. The wind is slowed down by passing through numerous windbreaks in the region and is also forced up off the ground. On a sunny day you will feel breezes and occasional gusts, but the soil moisture levels will be higher and you can produce at optimum growth. 1980 studies in Kent County, Ontario showed a soybean yield increase of 28.6% with windbreaks. Average yields were 43.6 but/acre in protected fields behind a double row of white spruce, essentially a windbreak acting as a solid wall.

Studies now show that a single row of trees is much more effective because more wind will pass through the trees with a lot of resistance, thereby reducing wind speed. The ideal windbreak should be 50% to 60% foliage like scotch and white pine or Norway spruce, not a dense thick wall which does not reduce wind speed, but only deflects n upward temporarily.

Woodland corridors

Now imagine Southern Ontario as a forest web, with farm fields protected by evergreen windbreaks and mid-field lower hedges for trapping snow Running north to south and deciduous tree windbreaks Running east to west to slow down the hot, dry spring and summer winds.

Between currently isolated woodlots, biologically diverse wooded corridors (windbreaks and shelterbelts) would support wildlife habitat. Watersheds would be planted with native vegetation to prevent stream siltation. Villages, towns and farm buildings would be protected from cold winds with greenbelts and windbreaks. This would be an energy conserving landscape that would fit together so that the tree planting activity of any one person would benefit the whole community.

The cumulative effect of using more appropriate windbreak design, and not relying only on dense trees like white cedar and white spruce, will produce an agricultural system that is genuinely sustainable, socially and environmentally, because H fits within the existing settlement pattern.

The land that is taken out of cultivation for shelterbelts is more than made up for in yield increases. Also, input costs are saved by not using fuel, time, seed, etc. on the land now occupied by the trees. When snow falls H would stay on the land and recharge the water table. A lot less soil would blow away during seeding and H may be that the rain would fall gently again and soak into the earth.

Further reading: L'Arbre et la Hale. Soltner. Sciences et Techniques Agricoles. 1988. This and other useful publications available through the Centre de Developpement d'Agrobiologie du Quebec (CDAQ), 422 Route Laliberte, Ste.Elizabeth de Warwick, Quebec, J0A 1M0, (819)358-5839

Henry Kock is the resident horticulturalist at the Arboretum at the University of Guelph. He is an active participant in the work of the Institute for Environment Policy and Stewardship (see insert).

Institute for Environmental Policy and Stewardship

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For further information regarding the Institute for Environmental Policy and Stewardship contact the Director, Professor Keith Ronald, at the Arboretum, University of Guelph, Ontario, Canada, N1G 2W1 or FAX (519) 763-9598.