Towards Sustainable Sugarcane Production

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The purpose of this paper is to describe and detail an alternative sustainable growing system for sugarcane.

The goal of this paper is to demonstrate a sustainable cane production system where high yielding, high CCS crops of cane are produced over many ratoons without the continual input of fertiliser, composts, or manures.

The paper will detail the establishment of a covercrop, predominantly composed of mixed annual legumes and grain grasses. It will describe how maintaining the covercrop by means of mowing, based on the principles of Rotational Grazing or Cell Grazing, will achieve the goal.

Definition of sustainability

The term Sustainable Agriculture is commonly and regularly used; however, concepts and opinions vary as to what the term actually implies.

To me **Sustainable Agriculture is: Growing vigorous, disease resistant crops without the continual input of synthetic or organic fertilisers whilst improving the physical and biological status of the soil over time.**

So, if production without the continual use of fertilisers and composts is possible, how might it be achieved?

We would need to achieve production by way of a sustainable source of energy/fertility. A definite source of sustainable energy is solar energy. If we could link agricultural production to incoming solar radiation, and moisture (ie rainfall and/or irrigation) then there could be the opportunity to achieve true sustainability in agriculture.

Achieving sustainability

The link that joins agriculture to solar energy, thereby making it sustainable, is the practice of **Cell Grazing.**

Cell Grazing is a practical understanding of how to manage and manipulate pastures, annual covercrops and weedy plants through grazing or mowing at very specific times and heights. This process will dramatically improve soil health and nutrient availability. It ensures high yields and high quality production. This understanding is based on the principles and results of Rational Grazing as described and documented by Andre Voisin in his book Grass Productivity (1)

The following photo clearly demonstrates this by showing the effect on plant cane growth by establishing a pasture as a break crop between ratoons.

Effect of a pasture break crop on plant cane Ingham N. QLD

Photo courtesy of the Sugar Yield Decline Joint Venture. Sugar Research and Development Corporation

The sugarcane on the left is the result of ploughing out a previous crop and replanting straight into the same paddock.

The cane on the right was planted at the same time but into a pasture that had been established and maintained for three years.

Clearly the sugarcane in the pasture treatment is demonstrating superior growth rates. This increase in production is entirely due to the ability of pasture to significantly improve soil fertility, particularly soil structure, drainage and carbon levels.

Fast growing cane reduces the need for weed control / herbicide application. This lowers costs and the likelihood of further soil compaction.

Limitations of using a pasture break

In sugarcane production world wide it is not economically viable take a given area out of production for three years in order to establish a pasture and maintain it. Currently in Australia many growers are planting a legume covercrop (Soya bean, peanut etc) as a break crop to improve soil Nitrogen levels and soil fertility. The covercrop is grown for approx. 6 months and the new sugarcane crop is planted into it either through minimum till or conventional tillage practices.

The research has demonstrated that there are improvements in yield and lower costs of production in the short term. However these benefits generally do not last for more than one to three years. Initial lower rates of fertiliser application need to increase as the improvements in soil fertility decline with successive crops. Higher rates of fertiliser generally lead to a further decline in soil fertility.

Covercrop species and management

Biological Design advocates an entirely different approach to soil fertility and covercrop management that more closely resembles the utilisation of pastures and their benefits. It is as a **once off** treatment at re-plant, designed to rebuild soil fertility in a period of four to six months, as opposed to three years.
A mixed species covercrop consisting of annual grain grasses (sorghum, millet, rice etc) and legumes (soya beans, peanuts, mung beans etc) is planted throughout (not in rows) in a flat seedbed. (2) The covercrop is mowed with a suitable light weight mower over the wet/summer season. Cutting is based on the principles of Cell Grazing

The method allows the covercrop to grow to approx. 300- 600mm and then to mow it down to approx. 150-200mm. This action supplies many tonnes per hectare of green manure to the soil surface. It also adds many tonnes of root material, approximately half of which die off as a consequence of the top being cut. This fine root material or organic matter is easily and readily digested by the soil biology.

As the covercrop regrows the roots forage deeper into the soil. When the covercrop reaches its optimum height of approx. 250-400mm it is cut again down to approx. 100-150mm. Another layer of green manure is deposited on the soil surface. Again half the roots die back and provide the soil biology with further readily digestible material. Similarly the green manure begins to breakdown and releases its nutrients. This process is repeated and dramatically improves soil health qualities such as soil structure, organic/carbon content, drainage, humus levels etc. These positive outcomes mimic the results of good pasture management as mentioned above and shown in the photo but are achieved in a much shorter time of 4-6 months.

Planting the Plant Crop

Planting of the sugarcane crop (billets) is done after the 2nd, 3rd or 4th mowing of the covercrop, without the addition of synthetic fertilisers and without cultivation. It is best performed using a light weight tractor, a no till direct billet planter, a double disc billet planter or similar implement. Ideally the planting channel should measure approx. 50mm wide by 125mm deep. After planting the cane the remnants of the covercrop and volunteer weeds regrow and after approx. 1 month 40% of the newly emerged cane shoots are visible. At this stage the remnant covercrop and cane shoots are cut as short as possible, approx 10 mm. This should be the final cut of the covercrop as annual grain grasses and legumes cannot tolerate being cut this short.

The cut cane and newly emerging cane shoots grow rapidly as there is ample fertility and soil structure provided by the decomposing green manure and covercrop root system. If required any covercrop or weed growth can be controlled with a single application of herbicide. After 3-4 months the vigorous plant crop begins to close the canopy and any covercrop or weed growth is suppressed. After 5-6 months the canopy is completely closed.

Harvest and sustainable production

The crop is harvested green with the trash returned. Most of the extensive root system dies off. This amounts to many tonnes of organic matter that can be rapidly recycled by the soil biology. This rapid recycling of organic matter provides sufficient fertility for the next crop without additional fertiliser. With each crop the roots forage deeper promoting deeper soil structure. Gradually the system moves towards an equilibrium where high levels of soil fertility are maintained whilst exporting large crops of high CCS sugarcane annually without fertiliser input.

The maintenance of highly fertile soil ensures that there will be no need to replant for many years.

Essentially this is a sustainable closed loop system driven by solar energy via a healthy and robust soil biology.

(1)Andre Voisin Grass Productivity Copyright 1959 Philosophical Library INC Published by Island Press.
(2) It may be an advantage to add soil amendments such as lime, trace elements, organic fertilisers and composts if available and depending on existing fertility levels.