Progress with Green Tea and Cultivated Sphagnum Moss Production

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At the I.P.P.S. Conference in Auckland 1988 (Vol. 38) I shared with you the methods developed for propagating over a million green tea cuttings at the time of establishing an industry here in New Zealand. Then I spoke in Christchurch (Vol. 45) about developments towards propagation of sphagnum moss as a cultivated crop in an artificial environment.

Because these things occurred here in the Nelson region I was asked to bring the Society up to date with developments and report on progress.

GREEN TEA

Green tea has the potential to be a broadacre crop for parts of New Zealand. The plant grows well and trial results showed it would yield satisfactorily. The cultivar Yabukita was planted on 95 ha by 21 farmers on soils ranging from the light fertile soils of the Motueka Valley and Plains, to the heavier soils of the Moutere.

A tea factory was imported and assembled in Motueka and became operational. Tea was produced and exported through the early 1990s and up to the 1996/97 season. The overall cost of equipment for harvesting and processing exceeded $1.25 million and the total investment probably in excess of $5 million.

On most fields the plants grew satisfactorily and the first harvest was made in October 1991, but things were not plain sailing. Serious frosts in November 1994 and 1995 ruined a large percentage of the higher valued first cut, putting the Cooperative behind their yield predictions and creating major problems for growers cash flow, and an early frost in February 1995 ruined most of the second crop that season. Today there are nine remaining farmers with approximately 25 ha being harvested. Some farmers were told by Japanese advisors that their land was unsatisfactory and left the industry. Certainly *Camellia sinensis* for tea production has fairly specific requirements with drainage and organic matter being important. The plants have a high requirement for nitrogen and this was being applied either as solid fertiliser or through trickle irrigation. The harvestable part of the plant is approximately 90% water and consequently is very vulnerable to frost and even chill factor from cold winds following precipitation can cause damage. High light levels also played an adverse effect on leaf quality turning the young shoots a lemon green. This was easily remedied by applying shadecloth over the rows for a few days prior to harvest. In as little as 96 h the leaves greened up, but this introduced another expense factor and an engineering problem in lifting and relaying the kilometres of cloth needed.

The cooperative began trading under the new name of Southern Cross Tea Cooperative in early 1997 and currently changes to its financial structure are also occurring.

More recently the extraction of antioxidants from tea has been investigated. Antioxidants are biologically active components found in fruits, vegetables, and tea and may have a role in cancer prevention. Over 150 nutritional studies have shown that people who eat adequate fresh fruit and vegetables have the best protection against cancers. The presence of these in green tea may account for lower cancer levels in nations consuming high quantities of green tea.

Though the Motueka venture has not reached its full potential, I firmly believe that New Zealand could be a successful green tea producer and exporter, if climate, soils, cultivars, and management are all suitable. Some parts of the North Island may be better suited than in the top of the South Island, despite its history of tobacco which required frost-free conditions for growth.

SPHAGNUM MOSS

My paper in 1995 was on a growth chamber experiment where we looked at the effects collecting location, light levels, and growth from three types of propagules had on growth of two species of sphagnum. Two years on from there we are looking at using the information gained from those experiments to grow moss on a pilot commercial scale in a totally artificial environment. Traditionally, sphagnum has been a horticultural commodity for lining baskets, germinating seed, etc. Other uses include medical ones for relief of pressure sores, absorption from open wounds and in sanitary products. The moss growing system we are developing is for these latter uses, and we expect this and the economics of growing will dictate a higher price for the product. All of these involve the naturally large moisture-holding capacity of sphagnum.

By growing in an artificial environment, grading to remove debris found in the wild is eliminated and our experience suggests the moss will not have the familiar brown banding layers of swamp moss and will in fact dry almost pure white thus eliminating chemical bleaching. Two growing systems are being investigated this year. Firstly in a twin-skinned Durophane covered tunnel house and secondly in an artificial pond situation.

1)Tunnel House Production. Removable wooden racks 1 m 5 1 m covered with tightly stretched knitted Ultraswind covers are the basic growing structure. These racks slide into a multitiered frame with a misting nozzle above the moss at each level. Moisture is controlled by a swing arm misting unit with a gauze leaf activating a mercury switch connected to 12v DC water pumps, of the type used on tractor-mounted spray booms. These are operated from a deep cycle battery, solar panel and through a battery charger connected to the mains as a back up to ensure no drying out. The racks are surrounded by Ultraswind to provide shade and reduce direct light and evaporation and a cover of the same material covers the outside greenhouse durophane. Racks on one half of the growing frame were initially seeded with a thin layer of sphagnum fines to provide a more natural moist growing medium, on the other, moss is just seeded onto the ultraswind. No differences are apparent between growth on the two substrates after $4^1/_2$ months. During the period January to mid April 1997 the greenhouse double doors at each end of the house were open for ventilation. In mid April they were closed and a small electric fan heater was placed in the tunnel and set to keep the night temperature just above freezing (3C). Closing the doors increased the overall humidity of the house considerably.

Growth from January set up time to mid March (7 weeks) was approximately 5 cm. At this time half of the moss on each frame was trimmed and a plastic grid placed on top of the cut surface, so that exact growth can be measured in future.

In previous greenhouse experiments cooler winter temperatures stopped growth, the moss became overwet and often discoloured. It is hoped that by maintaining temperatures above freezing, growth will continue over the low light, cold period. So far this whole system looks promising.

2)Artificial Swamp Production. Here wooden frames were set up and prepared to level. Each of the four ponds were lined with heavy grade black plastic and divided into four smaller beds each 1 m square. A pipe between each of these four beds maintained a constant water level in each. A series of drain holes in each pond enable water level to be raised or lowered as required by plugging holes to suit. They also enable excess water to drain automatically during rainfall. The water level in each pond is maintained constant through a header pool with a ballcock much the same as for maintaining the levels in a capillary bed. Above the ponds are spiral jet nozzles operated again by a swinging arm mist propagation unit controller and mercury switch to a solenoid valve, to allow for simulating rainfall. The moss surface never dries out. Each pond holds 24 plastic nursery hygiene propagation trays in four beds of six trays. *Sphagnum cristatum* was collected from two sources, Burnbrae (172° 15E, 42° 2 S altitude 400 m) and Tophouse (172° 55E,42° 40 S altitude approx 700 m), near Lake Rotoiti, and trays filled to be level with the tops. These were then set into the ponds. Growth for the first three months was similar to that in the tunnels when trimming was done. Trimmings were placed in further hygiene trays to continue growth

Individual beds were either shaded in one of two methods or not shaded. Water pH and nutrient levels are being monitored as are water temperatures. Temperature of the moss surface is being collected constantly using thermocouples connected to a data logger in both systems. Several beds within the ponds have been kept free of moss and one observation of interest is the distinct lack of algal growth in the presence of moss.

In 1995/96 season a moss trial grown in 25 cm 5 13 cm berryfruit trays in a greenhouse responded positively to small amounts of nutrient. In future the pH and the nutrient levels in this experiment will be adjusted and the growth responses measured.

SOME EXAMPLES OF CHEMICAL LEVELS

	Tap water	Burnbrae	2 weeks in pond
pH	6.6	4.6	7.7
Acidity	8.8	43	1.8
Nitrate N	0.24	0.04	0.09
Total P	0.0	2.5	0.0
Tannins	0.0	82	0.0
Hardness gm^3			
CaC_3	24	7	27
Potassium	0.88	3.3	1.1
Zinc	0.06	0.46	0.03

In future moss for medical use may be produced economically in greenhouses or artificial ponds.