Technology Development and Transfer Office

John C. Stennis Space Center

Successful Technology Commercialization

NASA-Developed Plant Health Measurement Technology is Becoming Big Business for Illinois Company

Developed by Spectrum Technologies, Inc., of Plainfield, IL, the CM 1000 chlorophyll meter has sold more than 140 units and generated the company more than $290,000 in revenues since its introduction in 2001. The CM 1000 identifies the failing health of a plant based on the chlorophyll content of the plant up to 16 days before it is physically detectable by the human eye. Poor health, "stress" in a plant, is a result of unfavorable growing conditions; lack of nutrients, insufficient water, disease or insect damage.

After only three years on the market, a technology developed by NASA to detect the health of a plant is proving to be a success. Through a non-exclusive license agreement with NASA, Spectrum Technologies, Inc., of Plainfield, IL is marketing a hand-held chlorophyll meter called the CM 1000. The product hit the market in Spectrum's 2001 Spring Product Catalog. To use the CM 1000, the user simply points the device at a plant in question and pulls the trigger. Within seconds the chlorophyll content of the subject plant is presented on an LCD screen. The meter works accurately at distances between 12 and 72 inches from the target. Although the cause of the plant stress is not identified, the use of this technology does allow time to identify the concern, correct the problem and, in most cases save, the plant. Anyone with a vested interest in a crop can benefit from use of the CM 1000.

HOT Points

- **Identifies plant stress; lack of nutrients, insufficient water and disease or insect damage**
- **Lowers cost and reduces processing time**
- **Ease of use**
- **Broad-base application areas; turf, crops and horticulture**

The device has typically been used by researchers for nitrogen analysis in cotton and potato crops. It is now currently being tested for use on turf grass. Turf grass quality, such as that on golf courses and sports fields, has recently gained a tremendous amount of interest in the area of horticulture. Increasing turf grass quality can help prevent injuries on sporting fields and can increase the satisfaction of playing golf.

Currently, turf researchers visually judge the health of the grass on a rating scale of one to nine, with one being dead and nine being the healthiest. This visual method is very subjective. The CM 1000 has the potential to provide an objective rating of the turf grass's color and quality.

Mike Thurow, founder and president of Spectrum Technologies, said that research has already been conducted in the turf grass market, and the company is just waiting on results to be published. He anticipates that, once proven, the device will have a tremendous market in the area of turf grass management.

"We know the technology works. But by having the researched published, it gives us the validity with the public that the technology works. That's the key," Thurow said. "It's what the CM 1000 needs to realize its potential in this market."

Another potential use is in the area of nitrogen fertility management. Nitrogen, one of the most common ingredients found in fertilizers, has the greatest environmental impact. If not managed correctly, nitrogen can end up tainting ground water supplies. The CM 1000 can potentially aid growers and consultants in fine-tuning nitrogen application.

The basic technology surrounding the CM 1000, measurement of a plant's chlorophyll content, has been used for almost a decade in this assistance. Previous methods using field spectroradiometers were expensive, cumbersome and time consuming. A device could cost up to $60,000, need linkage to a computer for operation, and require days of data processing to get the desired information. Scientists at John C. Stennis Space Center determined that by measuring the reflectance of a plant leaf at a specific waveband, the chlorophyll content of a plant leaf could be determined quickly and accurately. Research determined that regardless of the cause of stress, it is best indicated in the plant at 840/nm in the near infrared and at 700/nm in the red.

Using this information, the NASA scientists developed a prototype device that collected three light samples -- incident light from 100 percent reflectance sample, light from a lense blocked dark, and reflected light from the plant. The light collected was passed through a beam splitter and directed through a band pass filter – one at 840/ nm and one at 700/ nm – then onto a photodiode. The amplified photo-detector output was digitized and put into a microprocessor, which took five data points at both wavelengths, averaged the data and stored the results. Percent reflectance for each wavelength was computed by dividing the sample of the target plant by the 100 percent reflectance incident light sample.

Percent reflectance for each wavelength was computed by dividing the sample target plant by the 100 percent reflectance incident light sample. The level of stress was determined by dividing the 700nm percent reflectance by the 840nm percent reflectance. The results were displayed on a range of 0.1 for a healthy plant to 0.4 or greater for an unhealthy plant, although ratios form different plant species can vary.

Spectrum enhanced the NASA prototype by adding a built-in ambient light sensor that eliminated 100 per cent reflectance panel for meter calibration to ambient light. Other features include dual high-power lasers to identify the target, a software-activated data logger for storage, a display meter for measurement value, average data value and relative ambient light level; and hardware encasement with a pistol grip for ease of use. NASA scientists who developed the prototype were so impressed with the new product that they purchased two units last year.

The keys to the CM 1000 success are early detection, ease of use and accuracy with an immediate response. Including software and cables, the CM 1000 sells for less that $2,200 and runs off of 2 AAA batteries.

Thurow said he is excited about the possibilities ahead for the technology. "It's happening slowly, but it is happening," he said. "Any new technology like this takes a lot of patience, but it's a good technology and we're willing to wait."

Spectrum develops and markets problem-solving tools for nutrition management, weather and environmental management, soil and water quality and integrated pest management. To find out more about the CM 1000 contact Spectrum Technologies, Inc., at 1-800-248-8873, or visit the web site at www.specmeters.com.

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