ELECTRONIC COUNTER USE IN FOREST TREE NURSERIES

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Since the Mid 1960's, forest tree nurseries have gradually shifted to less labor intensive harvesting and packing techniques. This mechanization trend has necessitated development of methods to ascertain quantities of seedlings being packaged for shipment. This is a critical factor with operations that sell to the public. Most nurseries not using the traditional grading table counting method uses the weight system of determining package quantity. Other systems use volume measurements, seedling bed count and the grab or number of handfuls per thousand method. At best, there can be wide deviations from the actual count using these systems. These deviations cause administrators of forestry programs considerable frustration on the producing as well as receiving end of transactions.

With the advent of miniaturization in the electronic industries, the Georgia Forestry Commission began in 1981 to adapt this technology to the seedling counting problem.

After reviewing responses from a number of manufacturers of sensing devices, field testing began on the pulsed infrared through beam system. This system is used extensively in applications of detecting a uniform sized, clean target moving at a controlled velocity such as on conveying systems. Seedling detection requires the opposite capability of a detection device. An off-the-shelf device loaned by Motion Technology, Lilburn, Georgia, on first trial gave mixed results indicating certain refinements were necessary. After collaboration with their engineers the various intricacies of optics and detection seemed to become more adaptable to seedling counting. By regulating beam width, intensity and belt speed, a consistent seedling count of 95% accuracy was achieved.

Highlights of the Georgia Forestry Commission initial attempt to use this system is as follows:

These specifications must be considered in selecting a unit:

1. Fast Response Time: This is the detection and recovery by the unit relative to the velocity or speed and diameter of the target. The frequency in Mhz of the light pulse may also be considered. This may necessitate merging components from different manufacturers depending on the accessories needed for an operation.
2. Optics: A fast response source and detector with .8 mil seconds response time. Beware of specification claims. Switch response times are at best ambiguous. A manufacturer is hard-pressed to describe the response times of his units. He will choose a unit with capabilities that fall within the customer's environmental conditions of use. There are varying capabilities within the same model. One may exceed the minimum-maximum specs of that model. Just because the counter will count 1,000 times per sec, doesn't mean it will count 40 seedlings per second traveling at 70" per second on a lifting machine's belt.
3. Predetermined Counter Capability. The unit is set for a predetermined amount and will reset back to zero at the completion of the amount.
4. Output for Direct Outside Relay Switching. This is necessary to provide a mechanical means of marking or separating the flow of seedlings when the amount counted is reached, thus identifying each amount.

5. The unit should be resistant to outside electrical interference.

After much analysis, it was concluded that a counter and optics were needed to detect and register an object 1/8" in diameter spaced at least 1/8" apart and traveling 70" to 75" per second in a dirty environment.

Trials suggested fast response optics (light source-detector) at .8 millisecond response might do the job. The halo or light bounce around the target (seedling) due to the focal distance of target from the lens of the detector was alleviated by covering the lens with a bottle cap with a round opening or aperture 2/32" less diameter than the smallest target to be detected. This aperture was 3/4" in front of the lens. This allowed the target to pass up to 3/4" in front of this aperture and break the light beam.

ALIGNMENT OF LIGHT SOURCE AND DETECTOR (OPTICS)

The optic holders were mounted using a round dowel or rod to line them up. The receiving optic should be placed so that the seedlings pass not over 3/4" in front of its cover. The lens of the light source optic should be 5-6" opposite. The demodulator or the counter should have a glow bulb for alignment. An audio and visual component is also available for this purpose. A 3/4" diameter lens will allow considerable vertical and lateral movement of the optics in seeking the center of the light beam. Since this unit is capable of detecting at a 40' range, the amount of light through the aperture to the detector is adequate when turned to full intensity. If intensity is turned too low or alignment is with the light on the edge of the beam, erratic counts result. Excessive vibration of the optic mounts will

cause beam breaks resulting in overcounting.

RESULTS:

In most of the counts, a consistent ± 0 to 5% of actual seedling count has been achieved. Foreign material such as bermuda grass tends to give an undercount by blocking the beam and allowing seedlings to pass uncounted. A 2/32" aperture on the detector will let most seedlings less than 1/8" diameter pass undetected. The light will penetrate the needle cover on the stems. In fact, this light will penetrate paper and white plastic so lens covers should be of metal. The receiving optic can be mounted in a box like enclosure. A stem diameter less than 1/8" will be counted if the junction of suckers or limbs with the stem blocks the light beam. Buildup of splatter from mulch or sand on the stem will block the light and cause a count of the seedling when bed inventoring. Spacing between seedlings on the lifting belt is better if the belt runs faster than the forward motion of the lifter.

CONCLUSION:

Electronic counting has very good possibilities in seedling bed inventory, mechanical harvesting and in shed counting of seedlings for small packaging.

The Georgia Forestry Commission will endeavor to have operational counter use in seedbed inventoring and mechanical harvesting by the 1982-83 lifting season.

The mechanics of using the relay switching after each predetermined volume count is not yet resolved. It can be used to energize an audio signal such as a bell, activate a spacing device between each counted

thousand or to shift catching containers as each amount is counted. Sowing in narrow drills with precise spacing of seed will greatly enhance counter use in bed inventoring as well as the counting of seedlings while mechanically harvesting.

The Georgia Forestry Commission will use the following components assembled by Southern Belting and Transmission Company.

Model CB2-514-AOP-CBB-10AR10 DYNAPAR
Reset Counter, 4 decade, 12 VDC
Input, Relay Output

8760A-6501 OPCON DEMODULATOR
11 to 15.5 VDC Input, Open Collector
OUTPUT, .8 MSEC. Switching Time

1261B-100 OPCON Fast Response
Detector .8 MSEC Response Time

1160A-100 OPCON SOURCE

8905A PLUG IN OPCON BASE

Shielded for outside interference

Cost - $540.00

CALCULATION OF COUNTER RESPONSE TIME

Detect Time - .8 MSEC Minimum

Calculation of Detect Time:

$$\text{Target Width} - \text{Beam Width} = \frac{\text{Dark Width}}{\text{Belt Speed}} \text{ (in./MSEC)} = \text{Detect Time}$$

	Minimum Target Width		Beam Width (Aperture)		Dark Width				Detect Time	Remarks
(1/8")	.125"	-	(3/32")	.094	= .031	=	$\frac{.031}{.080}$	=	.387 M SEC	Too Fast Belt Speed
(1/8")	.125"	-	(1/16")	.063	= .062	=	$\frac{.062}{.080}$	=	.775 M SEC	Questionable
(1/8")	.125"	-	(1/16")	.063"	= .062	=	$\frac{.062}{.075}$	=	.826 M SEC	Acceptable
(1/8")	.125"	-	(1/16")	.063"	= .062	=	$\frac{.062}{.070}$	=	.885 M SEC	Acceptable

Minimum seedling spacing should equal the above target width at the above acceptable speed and beam width. Slower belt speeds gives more favorable detect times.

FOR FURTHER INFORMATION CONTACT:

COMPANY	PRODUCTS
Opcon, Inc. 720 80th Street, S. W. Everett, Washington 98203 AC 800 426-9184	Optics & Counters
Southern Belting 472 Plaza Drive, Suite C College Park, Georgia 30349 AC 404 767-1581	Opcon & Dynapar Components, Harvester Belts
Motion Tech 4791 Gresham Circle Lilburn, Georgia 30247 AC 404 972-5050	Engineering Factory Representatives
Dynapar Corporation 1675 Delany Road Gurnee, Illinois 60031 AC 312 662-2666	Counter