CENTER PIVOT IRRIGATION AND SOUTHERN PINE SEEDLING PRODUCTION

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ABSTRACT. Solid set irrigation is used almost exclusively in southern pine seedling production. An alternative to solid set irrigation is the center pivot. Weyerhaeuser company is developing a nursery in Aiken, S.C. which will use center pivot irrigation. Center pivot systems have a distinct advantage in water application uniformity over solid set systems. Higher coefficients of uniformity (C.U.) make possible the application of fertilizers, and pesticides through the irrigation system. A high C.U. means a more uniform cropping system. Seedling production strategies under a center pivot are very similar to those used with a solid set system. No significant equipment modifications are needed. The center pivot system allows irrigation of cover crop areas. Center pivot automation packages are available to control and monitor all operations.

SOLID set irrigation is used almost exclusively in southern pine seedling production. Advances in irrigation technology and demands for uniform 'quality' seedlings have challenged this exclusiveness. An alternative to solid set irrigation is the center pivot.

Before selecting an irrigation system some basic criteria describing irrigation requirements must be established. Criteria to identify irrigation system alternatives may include the following:

1. The irrigation system should be conclusive to the production of uniform high quality seedlings.
2. It should be affordable. The cost of the system should be consistent with the nursery's financial objectives and targets.
3. The system must be adaptive to site characteristics such as slope and soil type.
4. It should also be adaptive to any self imposed constraints. This could include site development constraints such as minimal or no leveling or cultural constraints.

Two alternatives were identified for the Weyerhaeuser nursery in Aiken S.C. These were solid set amd center pivot. The next step was to evaluate each alternative. Financial comparisons were made which examined capital expenditures, volumes, revenues, and seedling production costs. Cropping strategies required to produce a 'quality' seedling were also evaluated. These included but were not limited to irrigation uniformity, support equipment, chemigation and fertigation, growing of small seedlots, automation, and cover crop strategies. After going through the above analysis the best fit for the Aiken

site was center pivot system.

COMPONENTS OF CENTER PIVOT IRRIGATION

Center pivot consists of a single lateral which has one end anchored (the pivot point). The lateral, supported by drive unit towers, trusses and truss rods, moves in a circle around the pivot point. Water is supplied to the system at the pivot point. Most pivots are driven by 3 phase 480 volt 1.0 to 1.5 HP motors. The last tower or outside drive unit controls the speed the lateral moves. A minimum application rate is established for when the last tower is moving at its maximum speed (100%). To increased the amount of water applied the drive unit is slowed down until the desired rate is achieved. The drive towers are kept in alignment by the use of micro switches which tell the drive motor to run or stop. The center pivot unit will shut itself and water supply down if it gets out of alignment.

Water Application Packages

Water application packages use impact sprinklers or spray heads. The rotation impact sprinklers are identical to those used on solid set spystems. There are many more options with regard to spacing, nozzels, and pressures than with a solid set system. Sprinklers of nearly equal size may be spaced progressively closer down the length of the pivot. Sprinklers may be spaced evenly but sprinkler and nozzel size would increase when moving down the pivot. Another option is to use a combination of the two strategies. Closer spacing means more overlap of spray patterns and increased water application uniformity. Sprinklers generally operate in the 30 to 60 psi range.

Spray heads are a low pressure (10 to 20 psi) alternative to impact sprinklers. The spray head has no moving parts. A spray plate is mounted 3 to 4 inches from a nozzel. A stream of water flows through the nozzel and strikes the spray plate. A directional or full circle spray head may be used. The spray head may be mounted on top of the center pivot lateral or underneath on drops or booms. The low pressure requirements of a spray head reduces pumping requirements and costs. Evaporation losses and wind drift are significantly reduced with a low pressure system. How spray heads are utilized depends on crop requirements, soil properties, and prevailing weather conditions. Pressure regulators are placed in fromt of each spray head or sprinkler to maintain proper pressure and maximize application uniformity.

Center pivot's biggest advantage over a solid set system is water application uniformity. Using Christiansen's (1942) equation to measure irrigation uniformity center pivot generally has a 5 to 10 point advantage. A solid set system with wind between 2 and 5 mph will have a coefficient of uniformity (C.U.) of around 85 percent. This is based on a spacing of 40 x 60 feet. A center pivot system under similiar conditions will have a C.U. around 94 percent. The effects of wind are greater on a solid set than on a center pivot system.

Fertigation and Chemigation

The high C.U. associated with center pivot is ideal for fertigation and chemigation. Both practices are commonly used in agriculture. Nutrient mixes can be custom blended for application through the center pivot. Fertigation can eliminate all preplant fertilizers with the exception of lime. Nutrients can be applied frequently and in small amounts. This contrasts with the large amounts of nitrogen applied per application with a solid set system. Smaller amounts and more frequent applications mean more efficient use of fertilizer. The above strategy should use less fertilizer over the course of the growing season. Fertigation eliminates labor and most equipment costs when compared to granular fertilization.

Chemigation is the application of pesticides through the irrigation system. Chemigation strategies may differ slightly from a standard spray program. Herbicides used in pre-emergent weed control may be injected directly into the pivot. The herbicide and water then create a barrier to emerging weeds. Most pre-emergent herbicides are watered in for the same reason. Injection in this case also minimizes the exposure of seedlings to a herbicide. Goal is a good example of when to use this strategy.

A pesticide applied to the foliage should be mixed with a non-emulsifiable oil. The oil keeps the chemical from going into solution and being diluted. The water acts as a carrier much the same way as air does when spraying from a plane. Non-emulsifiable oil and chemical droplets are dispersed through out the water. The oil/chemical droplets stick to the plant when applied. Pesticides used in this manner include Bayleton, Poast, and Pydrin. Steps must be taken to prevent ground water contamination back through the well when fertigating or chemigating. This is easily accomplished with check valves located at the well and point of injection.

Cover Cropping

Another advantage of center pivot is the irrigation of cover crops. Cover crop areas may irrigated whenever appropriate. Fertigation and chemigation may be utilized as with seedling production. Cover crop irrigatiion may increase biomass production or at least guarantee it. Being able to irrigate regularly may also provide greater latitude in choosing a cover crop species. The number of years an area is taken out of seedling production may decrease with modified cultural strategies associated with irrigation. Finally, when preparing to **go** back into seedling production fumigants such as Vapam or Soil Prep may be applied through the irrigation system. Thorough testing of any chemical should be done before applying it through the irrigation system.

Support Equipment

The majority of equipment used in conjunction with solid set irri-

gation can be used with center pivot without modification. Specialized equipment such as harvesters, undercutters, and lateral pruners work as well on curved beds as on straight. Sowers may need some modification to insure correct seed placement and proper tracking. When fertigation and chemigation are used total equipment and labor requirements are reduced. Quality pumps and components should be used for all injection.

Automation

Automation packages are available to control and/or monitor a multitude of functions. Pivot automation may involve turning the pivot on or off, changing pivot speed and direction, and the control and monitoring of an injection pump. Other parameters which may be monitore include pivot location, water pressure and flow at the pivot. Pump operations controlled and/or monitored include starting and stopping, turbine lubrication, flow rates and pressure at the pump.

The simplest center pivot packages have automatic stops which shut down both the pivot and water supply. These stop are preset to shut the system down when the center pivot lateral reaches a certain position in the field. These packages are very inexpensive running into hundreds of dollars rather than thousands. Another standard safety device is an over-watering protector. Should the pivot stop moving for a certain lenth of time the pivot and pumps automatically shut down. An automation package that controls individual sprinklers or groups of sprinklers is available. A solenoid valve is placed at each point where control is desired. By controlling individual groups of sprinklers small crop areas may be isolated. This set up is ideal for the growing and culture of small seed lots.

Automation packages may be as simple or as sophisticated as desired. Auto stop functions, and manual speed and direction of travel are easily controlled at the pivot field panel. More sophisticated operations can be controlled remotely with a custom control board or with a PC. Pre-programed pivot and pump operations are ideal for the PC. When controlling pivot and pump operations from a remote location radio telemetry or hard wire communications may be used. Telemetry is especially effective over large areas or for large numbers of pivots. There is less risk to the system should it be struck by lightning.

Conclusion

Although new to southern pine seedling production center pivot irrigation is a proven alternative to solid set irrigation. The use of center pivot irrigation is nothing more than the transfer of technology from agriculture to southern pine seedling production. Center pivot is a viable and practical alternative to solid set irrigation that should be investigated when developing or modifying a seedling nursery.

Christiansen, J.E. 1942. Irrigation by sprinkling. Agr. Expt. Sta. Bul. 670, Univ. of Calif., Berkeley.