Irrigation Equipment

Center Pivot / Linear Move Systems

Center Pivot and Linear Move systems are closely related - they both use a motorized tower/overhead sprinkler concept and use similarly-sized towers and equipment for comparable acreages. The main difference between them is the mode of travel. Some Center Pivots can be ordered with a package to convert them to a Linear Move system. Since both systems are similar, information on center pivots is provided here first to give a basic understanding of the equipment, with additional information and characteristics about linear move systems provided later.

Center Pivots

Figure 1. A small, 2-span Center Pivot with end gun

A Center Pivot system does just what the name implies - it "pivots" around a central point known as the "pivot point" or "pivot pad" (Figure 2). Center pivots come in a myriad of sizes, from 1 acre up to 400 acres or more. Pivots are generally economically feasible (relative to other types of irrigation system) when 40 acres or more are irrigated under a single pivot, and are generally the least expensive option when more than 60 acres are irrigated.

Figure 2. A pivot point or "pad" and pump house

Irrigation of various field sizes is made possible by using a variety of lengths of "spans" between the supporting "towers" (Figure 3). The length of each individual span can be from 100 to 200 feet or more. Combining several different lengths of spans enables accommodation of almost any size field.

Figure 3. A pivot "span" tower

Center pivots generally have an end gun attached to the last tower on an end boom to increase the irrigated area (Figure 4). Since this end gun is supported on an extended boom and does not have a supporting tower directly under it, this addition can greatly increase a pivot's irrigated acreage without requiring additional land clearing. For instance, a 750 foot long pivot installed on a given field will cover 40.5 acres. Add an end gun capable of irrigating another 120 feet and the irrigated acreage is increased to 54.5 acres if the gun is able to operate for the entire circle. The end gun can have an automatic shutoff installed on the pivot point to turn it off when the gun would water non-crop areas such as residence yards, buildings, roads, or forests..

Figure 4. Close-up of a pivot end gun on a boom in operation

The major advantages of a center pivot system are the low labor requirement and the circular travel path. Operating a pivot is a simple job of turning the pivot on and can be done easily by one man (unless the pumping station is a considerable distance away from the pivot). The only other labor required involves regular checks of the pivot to make sure it is operating correctly and has not encountered any unexpected obstructions. The circular travel path means that the pivot will end

its irrigation cycle at the same point where it initially started, so the next irrigation cycle will begin at the driest point in the field.

The major limitation of a center pivot is also, oddly enough, its circular travel path. Since the entire machine moves as a single line of spans and towers, the spans at the outer edge of the field must travel considerably faster (and thus cover more area) than those near the pivot point. This means there is a point where applying a given amount of water from these end spans is not possible due to soil characteristics and/or pump and piping limitations. Additionally, care must be used when considering the frequency of watering. If the pivot requires 96 hours to apply a given amount of water to the field and the crop growth stage, climate, and soil type determine that this amount of water is needed every 72 hours, the irrigator will "fall behind" until climate conditions improve. Center Pivot designers have this consideration and others in mind during design of each system, but it is good for the grower to understand this point.

In many instances it is not economically feasible to design the system to provide the maximum water need for the crop. Many center pivots installed for cropping systems including corn are designed to apply a maximum of 2 inches (gross) of water per week, even though corn can use up to 2.5 inches per week during peak water use periods. A system designed to apply 2.5 inches per week apparently costs more than the added corn yields will provide in return.

Another point to consider is the so-called "windshield wiper" pivot installation. In many instances it is less expensive to irrigate a long, narrow field with a single center pivot designed to operate in a half-circle configuration than to install two smaller, full circle pivots. These half-circle pivots have all of the benefits and drawbacks of a normal pivot with two additions - (1) Since the pivot does not automatically return to its original starting point, the grower may have to run the pivot "dry" back to that point before irrigating again, which adds wear to the system, and (2) if the pivot is not returned to its original starting point before the next irrigation cycle is started, the driest area of the field (that was irrigated first during the last cycle) will receive water last.

Center Pivots are available that have a "trailing" tower to irrigate the corners of a field. This trailing tower follows a buried cable or some other guidance system and lags behind the rest of the spans where the pivot "circle" reaches the edge of the field. This trailing span extends to line up with the rest of the pivot as the system approaches a field corner to irrigate that area, then retracts or "lags behind" again as the pivot continues around to prevent contact with obstructions at the field edge.

Many center pivots are also available in a "towable pivot" configuration. This allows the pivot to be moved or "towed" by a tractor from one pivot point to another to increase usefulness and decrease capital costs. Pivots withstand this

type of movement well when they are moved once or twice per year, but any attempt to move a pivot weekly is a wasted effort both in terms of crop water management and wear and tear on the pivot structure. Moving a pivot between two pivot points will take between 6 and 12 hours as a rule. Towable pivots are best used when there are two different cropping systems under the two pivot points. The first crop is irrigated until it reaches maturity, then the pivot is moved to the second pivot point to irrigate the second crop with a much later maturity.

Linear Move Systems

Figure 5. A Linear Move system. Notice the concrete water supply channel (and the fact that the system spans both sides of the channel).

All of the points listed for center pivots can be easily applied to linear move systems with two exceptions - travel path and water inlet.

A linear move system does just what its name implies - it moves in a linear or straight line path. One design of linear move system covers the entire width of the field and waters the entire field in one pass. This would be synonymous with the "windshield wiper" pivot mentioned above - after the irrigation cycle is completed the machine is located at the far end of the field that was irrigated. To start the next irrigation cycle on the driest area of the field, the linear move machine must be "run dry" back to the original starting point, which adds wear and tear.

Another type of linear move design involves installing a linear move machine that only covers one-half of the width of the field. This system irrigates one-half of the field in one pass. At the end of this pass, the machine is rotated 180 degrees (manually with the help of the motorized towers) and is set up to return down the other side of the field, watering the other half. This system most closely resembles the full-circle center pivot system in that the machine ends the irrigation cycle at its

original starting point. The drawback to this system is that there is some labor requirement to re-orient the system at each end of the field.

The water supply for the linear move obviously cannot be supplied by a central pivot point such as that used for the center pivot. One method of water supply involves the use of a flexible "drag hose" that is attached to an underground piping system. The drag hose system utilizes attachments to riser points similar to those used for traveling gun systems. Depending on the length of run of the system, the attachment point may need to be moved between two or three supply points (or remain attached to a single point) during one pass. This adds to the labor requirement, but not substantially.

> The other option involves a natural (Figure 6) or concrete (Figure 5 above) ditch or channel with a suction assembly extending into the ditch from the linear move machine. This removes the labor of moving the inlet hose, but adds water losses due to evaporation, and in the case of the natural channel, seepage into the ground. Certain soil types will require a concrete or lined channel to prevent large seepage losses. This water supply option may or may not be viable depending on the topography of the field. In either of these options a pump is placed on the machine itself and travels with the system.

Figure 6. A linear move system drawing water from a natural channel. (image source unknown)