COTTON

INCREASING COTTON YIELDS
THROUGH EFFICIENT IRRIGATION SOLUTIONS

HIGHER YIELDS. . . LOWER COSTS. . .
PRECISION APPLICATION

LINDSAY™

Why irrigate?

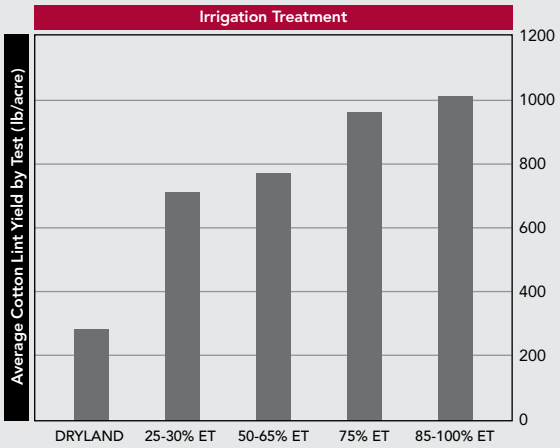
The correct amount of water on your cotton crop is essential for producing high yields. Zimmatic® irrigation systems bring a cost-effective solution, alleviating risk when the weather isn't cooperating. They also give you more flexibility when it comes to planting, because your timeline is not as affected by nature.

Proper irrigation management minimizes yield loss due to crop water stress, optimizes yield per unit of water applied and promotes good management practices. The result is a greater return on investment.

COTTON YIELD FOR DIFFERING RELATIVE IRRIGATION AMOUNTS

Cotton yields as influenced by the difference between irrigation and evapotranspiration (ET).

J.P. Bordovsky, J.W. Keeling and K. Bronson. "Summary of Cotton Yield Response to LEPA Irrigation Quantity at AG-CARES, 1990-2002."



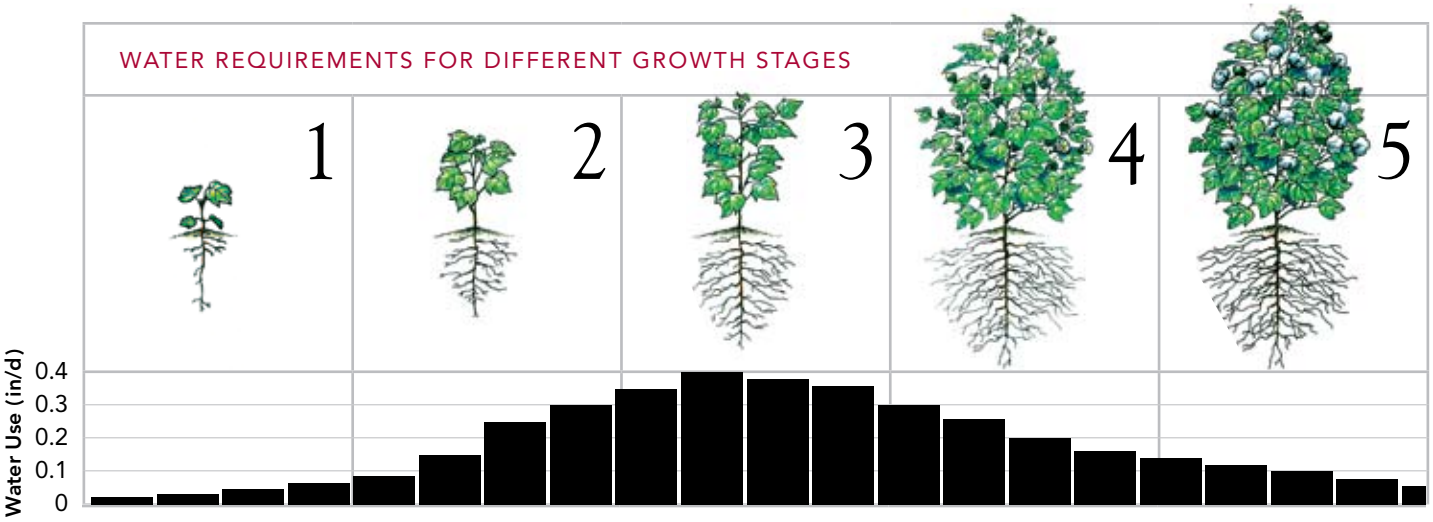
IRRIGATION IMPACTS EVERY STAGE OF GROWTH

From establishment to harvest, effective water management is important at each stage of cotton growth. At Lindsay, we take into account many factors when designing irrigation systems to meet your specific needs, such as local microclimate, soil type and elevation.

Cotton plant responses to water stress vary depending on the stage of growth at which the stress occurs, the degree of stress, and the length of time the stress is imposed.[1]

The plant aims to establish a balance between carbohydrate supply and demand. Water stress at any stage of growth will affect both the production and distribution of carbohydrates throughout the plant, as well as shortening of fibers. Carbohydrate demands on the plant, primarily made by developing bolls, restrict excessive vegetative growth.

WATER REQUIREMENTS FOR DIFFERENT GROWTH STAGES



1-Emergence:
Adequate moisture at seeding enhances root development to establish healthy, uniform stands.

2-Squaring:
Avoidance of water-deficit stress beginning at first square is critical in developing adequate plant structure to facilitate yield goals.

3-First White Bloom:
Suffficient moisture before the first bloom provides water for pollination processes and should be at or near field capacity.

4-Peak Bloom:
Water use reaches a maximum during peak bloom. Frequent irrigation (every 2 days) of small amounts of water (0.20 – 0.25 in) has been shown to be effective.

5-First Open Boll:
Control of late-season irrigation is essential. Irrigation (by pivot) should continue until 20% of bolls are open (1-2 weeks after first open boll).

Denise McWilliams, Department of Extension Plant Sciences, New Mexico State University, Las Cruces, New Mexico. "Drought Strategies for Cotton."

Water Requirements

Cotton is considered a drought-tolerant crop, yet it responds well to sufficient water. Depending on climate and length of the total growing period, cotton needs 27 to 51 inches (700 to 1300 mm) to meet its water requirements (ETm). In the early vegetative period, crop water requirements equal 10 percent of total. They are high during the flowering period when leaf area is at its maximum – 50 to 60 percent of total.

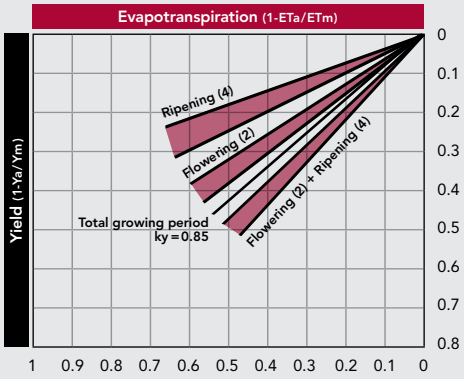
A good yield of a 160- to 180-day cotton crop under irrigation is 3500-4500 lb/acre (4 to 5 ton/ha) seed cotton of which 35 percent is lint. Water utilization efficiency for harvested yield for seed cotton containing about 10 percent moisture is 90-135 lb/ac-in (0.4 to 0.6 kg/m3).[2]

Monitoring Evapotranspiration

To effectively plan irrigation, growers need to account for evapotranspiration (ET). Evaporation is the total water use of a crop, including evaporation from the soil and transpiration by the plant. Humidity, solar radiation, wind, as well as crop health and growth stage affect evapotranspiration.

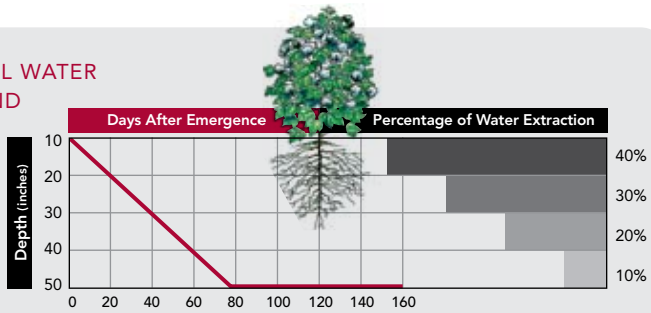
EVAPOTRANSPIRATION DEFICIT IMPACT ON COTTON YIELD

http://www.fao.org/landandwater/aglw/cropwater/cotton.stm



ROOT ZONE SOIL WATER EXTRACTION AND PLANT ROOT DEVELOPMENT PATTERNS

Guy Fipps, Texas Agriculture Extension Service. "Soil Moisture Management."



To measure and monitor crop evapotranspiration, access to the following information is needed:

1. A local weather station report that estimates cotton crop ET.
2. A rain gauge placed in each field or group of adjacent fields.
3. A good estimate of the allowable water depletion for the soil (this can be calculated by extension agents and crop consultants).

Irrigation Optimization

To enhance root development, adequate water should be available in the soil at the time of sowing and pre-irrigation is required when stored soil water from pre-season rainfall is not available. In the vegetative period, irrigation may be scheduled when some 60 percent of the available soil water over the first 2.5 ft (0.75m) has been taken up by the crop. During flowering, depletion of some 70 percent of available soil water will in general check vegetative growth without impairing yields; delayed irrigation during this period may cause excessive flower and square shedding.

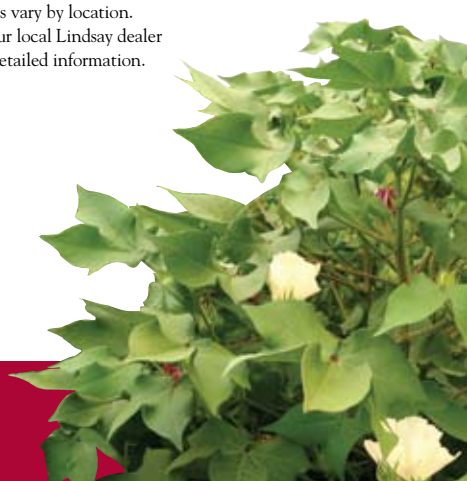
During yield formation (boll filling) and ripening, the soil water depletion may increase from 60 percent to higher values as the season progresses, and depending on climate and depth of stored soil water, irrigation can be terminated 4 to 5 weeks before final picking.[2]

References

[1] http://www.cottoncrc.org.au/files/d3d58a2a-dab6-47e6-9584-992b0096f977/WP3_1.pdf

[2] http://www.fao.org/landandwater/aglw/cropwater/cotton.stm

Conditions vary by location. Talk to your local Lindsay dealer for more detailed information.



Zimmatic center pivot with LEPA

REDUCING FERTILIZER EXPENSE WITHOUT SACRIFICING YIELD

Cotton response to six nitrogen (N) fertilization rates under furrow irrigated and moderate frequency center pivot irrigated (MFCP) conditions.

N Rate	MFCP	Furrow
150 (167)	1262 (1413)	1334 (1494)
120 (134)	1394 (1562)	1347 (1509)
90 (100)	1525 (1708)	1248 (1398)
60 (67)	1346 (1508)	1198 (1342)
30 (33)	1255 (1405)	1027 (1150)
0	1185 (1327)	784 (878)
lb N/Acre (kg/ha)	**lb Lint/Acre** (kg Lint/ha)	

J. Scott McConnell and William H. Baker. "Reducing Fertilizer Expenses Without Sacrificing Yield."

FERTIGATION

Fertigation is an efficient method of supplying part of the nitrogen (N) needed for a cotton crop through the irrigation system, near the time of maximum nitrogen uptake.

Cotton is grown on a wide range of soils but medium and heavy textured, deep soils with good water holding characteristics are preferred. Acid or dense subsoils limit root penetration. The pH range is 5.5 to 8 with 7 to 8 regarded as optimum. The fertilizer requirements of cotton under irrigation are 90-160 lb. per acre (100 to 180 kg/ha) N, 20-50 lb. per acre (20 to 60 kg/ha) P and 45-70 lb. per acre (50 to 80 kg/ha) K. Two-thirds of the nutrients are taken up during the first 60 days of the growing period. Nitrogen should be readily available at the start of the growing season; normally two applications are given with one after sowing and the other prior to flowering. Phosphate is applied before sowing. Plant spacing normally varies between 20 to 40 x 12 to 20 inches (50 to 100 x 30 to 50 cm).

http://www.fao.org/landandwater/aglw/cropwater/cotton.stm

EFFICIENT APPLICATION FOR HIGHER YIELDS

Zimmatic Center Pivot Irrigation – Custom-fit your irrigation system to your fields for uniform application.

Zimmatic Lateral Irrigation – Irrigate 98% of square or rectangular fields, and tow your irrigation system between fields.

References

[1] Vernon D. Lansford and Eduardo Segarra, Department of Agricultural and Applied Economics, Texas Tech University, Lubbock, Texas. James P. Bordovsky, Texas Agricultural Experiment Station, Halfway, Texas. "The Dollars and Cents of Subsurface Drip Irrigation (SDI) for Cotton in the Southern High Plains of Texas."

[2] Freddie Lamm, Daniel O'Brien, Danny Rodgers, Troy Dumler "Sensitivity of Center Pivot Sprinkler and SDI Economic Comparisons" American Society of Agricultural Engineers (ASAE).

Why pivots/laterals?

Pivot/lateral irrigation systems – right amount, right time, right place

Applying the correct amount of water at the right time is crucial to getting a good yield, but it's also important to apply it uniformly.

Pivots/laterals v. flood irrigation

Less waste

The most obvious benefit to irrigating with a pivot or lateral system is that it produces less waste. You get even, precise water application across the rows (Figure A), rather than having too much water at the upper end, and not enough water at the other end of the field (Figure B). You won't lose water to evaporation, and you can control the timing and amount of water that is applied. There's also less runoff, helping prevent contamination of the water table and nearby streams.

Figure A
Pivot/lateral irrigation

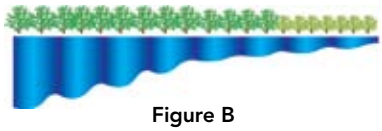


Figure B
Flood irrigation

Lower labor costs

The Zimmatic irrigation system by Lindsay is automated, so no one has to move pipes, or open and close floodgates. There are no ditches to maintain for pivots. One irrigator can operate as many as 25 pivots. Plus, remote control and monitoring options are available.

Higher return on investment

The long life of a pivot or lateral system will save you money year after year. You'll use less water, reducing your energy costs. A Zimmatic pivot or lateral system also applies chemicals and fertilizers evenly, accurately and inexpensively. All this adds up to consistently higher yields.

Pivots/laterals v. drip

Fewer maintenance hassles and labor costs

Compared to an SDI system, maintenance is extremely simple for pivot and lateral systems. There is no emitter clogging and requires only a screened intake. Rodents, roots and cultivation equipment won't damage your system.

Greater return on investment

The cost of SDI may increase sharply if a field is irregularly shaped or elongated. Many factors influence the cost of SDI and growers should consult a dealer with design software to get an accurate estimate of cost.

SDI requires a higher level of management than pivot irrigation with LEPA to achieve higher lint yields and increased cotton fiber quality.[1]

Better all-around value

- Lower investment cost per acre than SDI for a savings of 20-200% – 65% lower for 123.5 acres (50 ha)
- Longer system life – 20+ years for pivot irrigation compared to 10 years for SDI
- Mortgageable and recoverable asset with realizable resale value
- Easier to finance
- Removable
- 95% recyclable materials[2]

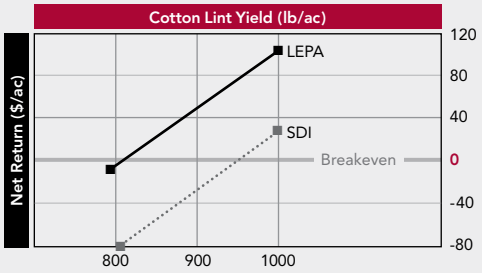
Pivots/laterals v. dryland

Flexibility of planting time; high germination rates

Pivot/lateral irrigation provides insurance against yield loss from drought or inconsistent rainfall, along with the following benefits:

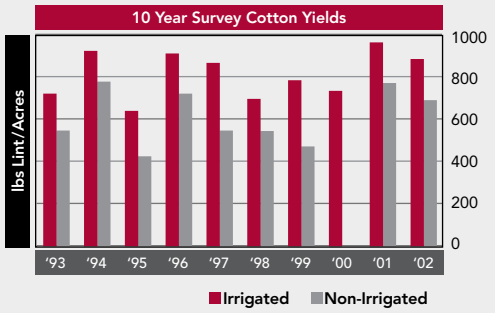
- Increased yield per acre (ha)
- Precise water distribution within the whole root zone
- Precise fertilizer application to prevent deep percolation and runoff

IRRIGATED vs. DRIP
NET RETURNS



James P. Bordovsky and William M. Lyle, Texas Agricultural Experiment Station, Texas A&M University, Lubbock, Texas. Eduardo Segarra, Agricultural and Applied Economics, Texas Tech University, Lubbock, Texas. "Economic Evaluation of Texas High Plains Cotton Irrigated by LEPA and Subsurface Drip."

IRRIGATED vs. DRYLAND YIELDS



Joe Henggeler, University of Missouri Outreach & Extension Service. "2002 Bootheel Irrigation Survey."

Why Lindsay?

Tough, dependable Lindsay irrigation systems have been the choice of the world's irrigators for more than 30 years. Lindsay irrigation systems pay for themselves many times over during their lifespan, and alleviate risk when weather conditions are not ideal for planting and growing conditions.

Yields: *maximized*

A Lindsay irrigation system can provide proper application to every part of a field throughout the growing season, even in those areas that are currently underutilized. Only Lindsay offers powerful, easy-to-use GrowSmart™ irrigation management products.

Energy, water, labor and time: *saved*

When compared to other irrigation methods, a Lindsay system will help maximize crop yields while using less energy, water, labor and time. Flexible, intuitive GrowSmart control products make scheduling and operation simple, while Web-based remote control options offer comprehensive monitoring and management.

Application: *precision*

Zimmatic dealers analyze each grower's operation to customize a sprinkler package based on crop and climate conditions.

Downtime: *minimized*

Lindsay irrigation systems are designed and engineered for life on the farm. They're constructed using only the highest quality components for superior performance season after season.

Support: *certified*

Our network of certified dealers is trained to customize, install and service our entire range of irrigation systems.

Watertronics – Customized pump stations for maximum efficiency

Each pump station is engineered based on your needs and field conditions to ensure peak performance.

- All components are integrated and housed in one complete unit
- Precision energy efficiency Variable Frequency Drive provides immediate energy savings
- Simple monitoring and control
- Continuous surge-free pressure regulation for enhanced efficiencies
- Horizontal and vertical pump stations available

Also available as an economical pump control upgrade for existing pumps.

Machines to fit your field

Zimmatic offers irrigation options like center pivots, lateral moves or MAXField Custom Corner systems that can handle anything from irregular fields to rugged terrain to multiple crops.

Durability

Heavy-duty spans, trusses and drive trains deliver even water distribution. There are varying heights to provide the proper irrigation for different types of crops – proven to withstand the elements in nearly any environment.

Control panels

Depending on your needs, each user-friendly GrowSmart control panel offers a different level of control, convenience and maintenance options.

Zimmatic lateral move

The right pivot option for any field or terrain

Lindsay has the pivot options to increase water efficiency and maximize yield. Lindsay offers durable parts, quality components and a range of tower heights for crop clearance and stable operation on varying terrain.

LEPA sprinklers

Operating in either bubble and spray modes, LEPA (Low Energy Precision Application) nozzles are designed to reduce surface evaporation.

Customized sprinkler packages

Rotating-spray, fixed-spray and LEPA sprinklers provide a variety of coverage and pressure solutions to fit your specific field/ crop conditions and needs.

SmartDesign

This program allows the dealer to design and review with you an irrigation system that fits your specific field to optimize acreage utilized for increased ROI. Determine field boundaries, obstacles, system length, and total irrigated acres to increase application accuracy and efficiency.

FieldNET™

FieldNET builds a network between pivots, providing full control and monitoring capabilities. It's the industry's first completely Web-based, real-time irrigation management system that provides a view of every pivot, including location, status and water usage. Managing pumps is more efficient with a pump control service package.

Zimmatic center pivot with LEPA on cotton

An international irrigation leader

Lindsay has a worldwide dealer network with warehouses in Nebraska, Texas and Idaho; factories in the United States, China, Brazil, France, and South Africa; and additional sales offices in Argentina, Australia, China, Egypt and Guatemala.

We can coordinate a variety of resources to implement turnkey irrigation systems wherever they're needed, through our dealer network or Lindsay resources.

For more information on cotton and other crop specific irrigation solutions, visit www.zimmatic.com/keycrops/ or talk with your Lindsay dealer.

LINDSAY™

Zimmatic STRENGTH TO GROW ON

GROWSMART Technology that Thinks Like You

greenfield Big Efficiencies in Small-Field Irrigation

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Lean, Clean and Green. Lindsay Corporation is committed to developing environmental awareness and implementing sustainable practices to reduce the use of and protect energy, water, and all other resources.

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