PEANUT

INCREASING PEANUT YIELDS
THROUGH EFFICIENT IRRIGATION SOLUTIONS

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

LINDSAY™

Why irrigate?

Peanut producers who consistently rank among the best know that water management is crucial to high yields and high quality. Peanut plants, although somewhat drought tolerant, cannot produce the high yields that growers need to remain competitive in today's market unless the plants receive adequate water in a timely manner throughout the season.

Peanuts typically require from 16 to 30 inches (41 to 76 cm) of water per season to produce top yields. This will vary depending on the air and soil temperatures, humidity, radiation and wind.

Because of the uncertainties of the weather, producers need to have a dependable water supply for their peanuts. Irrigation ensures that water will be available at critical peanut growing stages.

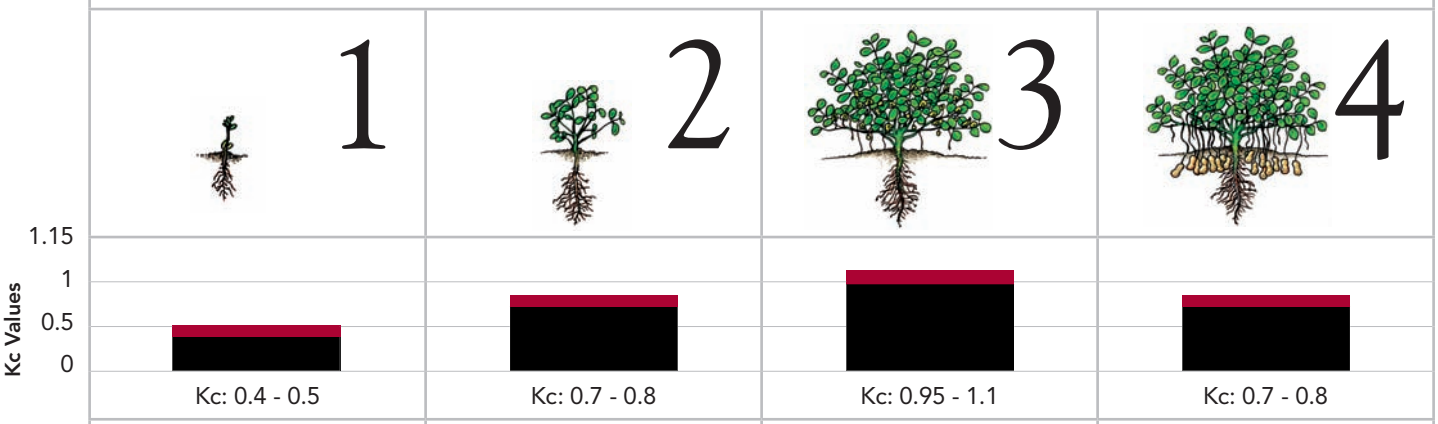
IRRIGATION SUPPLIES MANY BENEFITS:

- Seed germination is assured
- Water is available throughout the growing season
- Production risks are minimized
- Soil-applied pesticides are activated
- Pods mature uniformly
- Nutrient uptake is enhanced
- Heat stress is reduced
- Crop maturation occurs more evenly
- Harvesting is easier when soils are not dry during digging
- The level of aflatoxin in the pods and kernels is reduced
- Late season spider mite problems are reduced in dry years

WATER REQUIREMENTS DURING THE PEANUT LIFE CYCLE

The growing season for peanuts can be divided into three distinct phases: pre-bloom/bloom, pegging/pod set and pod fill/maturity. Prior to bloom, peanuts are in a vegetative growth stage; the reproductive stage begins at bloom and continues through pod-fill and maturity. Although the need for water varies during each growth period, irrigation may mean the difference between economic success and economic failure.

CROP COEFFICIENTS (Kc) USED FOR WATER MANAGEMENT



Pre-bloom: Germination occurs 5 -10 days after planting, depending on sowing depth, soil moisture and type of plant. Seeds must absorb about 50% of their weight in water before germination can begin.

Crop Development: Slow growth for 40 days, with flowering beginning 25 - 40 days after planting. Soil moisture is key to plant development at this stage, affecting primary root length and the number of pods produced.

Mid-Season: Four to five times faster growth occurs between 40 - 100 days after planting. Moisture availability and temperature greatly influence flowering period.

Late-Season: 100 - 130 days after planting pods and nuts develop. Moist soil eases harvesting at this stage.

Sources: Crop Water Management, AGLW Water Management Group http://www.fao.org/landandwater/aglw/cropwater/groundnut.stm

"Texas Peanut Production Guide," Texas A&M University, 1996. http://soil-testing.tamu.edu/publications/751754-747850-B1514.PDF

Note: A better uniformity coefficient alone does not ensure more yield if the overall crop water requirement is not met and results in a water deficit. Stated Kc values are an average. Local Kc values will vary with local microclimate, terrain and peanut type.

Early season water requirements

The germination period is a critical time for water management. Seeds must absorb about 50% of their weight in water before the germination process can proceed. Dry soils or drought conditions at this time reduce germination and can cause significant delays in emergence. These delays can complicate fullseason management, if the crop emerges over a very long period or fails to emerge at all.

Vegetative growth is slow during the first three to four weeks when the plant is producing leaves and stems. As more leaves are produced and photosynthesis increases, growth becomes more rapid. If drought conditions occur during this time, photosynthesis slows or stops and growth can be severely affected. Irrigation is the only method of assuring that adequate water resources are available during this rapid growth period.

Pre-emergence herbicides and planting time insecticides or nematicides require moisture for activation. Timely irrigation can help maximize the efficacy of these pesticides and reduce the need for post-emergence weed control applications and additional expenses.

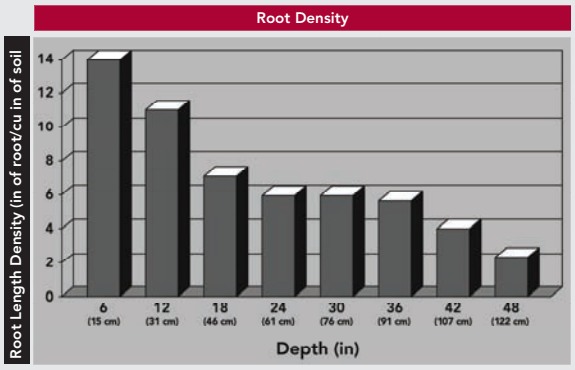
The importance of roots in water uptake

Water uptake is affected by the available water and the volume of the root system. The term "available water" refers to that amount of water held in the soil that is available for uptake by the plant. The upper limit of water held in the soil reserve is the "field capacity;" the lower limit is the "permanent wilting point" or the point at which plants do not recover from lack of water.

The greater the development of lateral roots and the deeper the penetration of the taproot, the greater the uptake capability for water. Sandy soils, which are typically used for peanut production, will not hold water as well as heavier soils; however plant roots have more difficulty penetrating heavier soils. Peanut roots have been found to grow to a depth of about 9.2 feet (2.8 m) in fine sandy soils but only to 4 feet (1.2 m) in heavier sandy loam soil. Different peanut genotypes tend to have different rooting characteristics. Differences are found in the length of the taproot, the production of lateral roots and the volume of the root system.

The volume of roots at varying soil depths is important to know, to help understand the critical nature of maintaining adequate soil moisture.

ROOT LENGTH DENSITY OF PEANUT PLANTS AT 80 DAYS AFTER PLANTING IN A TELLER SANDY LOAM SOIL. PLANTS WERE WELL IRRIGATED.



Source: Melouk, Hassan A. and Frederick M. Shokes, "Peanut Health Management," American Phytopathological Society, 1995.

Considering the volume of roots at the 6 to 12 inch (15 to 31 cm) depth, it is easy to see how important the management of water is to maintaining plant health. Plant spacing also influences root development and water uptake. Dense plantings have a reduced root mass at the 6 to 12 inch (15 to 31 cm) depth; they use water at higher rates than thinner stands; and they deplete the soil of water more quickly. Under irrigation, denser stands can be maintained and relative yields improved.

Mid-season water requirements

Once plants reach the reproductive stage of development, water management becomes extremely important. At this stage, soil moisture levels should not drop below 50 to 60% plant available water. Irrigation provides a dependable water supply that improves blooming, pegging and pod set.

Water stress during blooming can delay or inhibit the opening of flowers. Peanut flowers open in response to high humidity in the canopy. Pegs penetrate the soil only if there is enough soil moisture and the soil temperatures are cool. Inadequate water supplies can delay or prevent pegging, causing significant yield losses.

Low soil moisture levels can also affect the maturity of the pegs. Early pegs are generally larger and take longer to mature than later pegs, which are set farther out on the branches. Since pegging begins near the taproot and continues outward, a stable water source is needed throughout this period to develop the pegs. Once pegging begins, the pegging zone should be kept moist even if adequate moisture is present in the soil. High moisture at this time improves calcium uptake, essential for pod filling.

Pegs may also fail to penetrate the soil and develop pods if soils are dry or if soil temperatures are high. Irrigation will increase soil moisture levels and also cool the soil. If water supplies are limiting at this time, maturity of the later-set pods can also be affected.

Late season water requirements

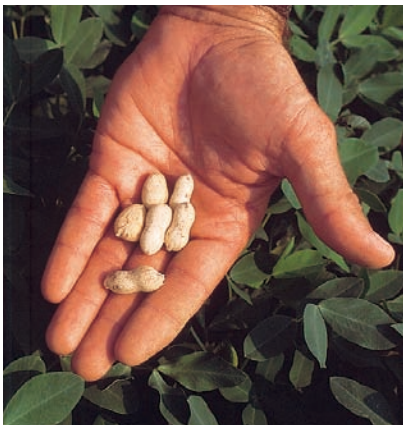
Yields of harvestable pods are set between 50 and 100 days after planting. After about 105 days, limited growth occurs except for the Southern Runner variety that continues vegetative growth until harvest. Irrigation can significantly increase yields, if applied during the pod set period and on an "as needed" basis from 100 days to harvest.

During maturation of the crop, water is not as critical and rainfall may be adequate. Plants have moderate resistance to drought during maturation, and excessive moisture can promote plant diseases. In dry years, the threat of aflatoxin contamination from the development of the fungus *Aspergillus flavus* is a real threat.

Also, dry weather promotes the development of outbreaks of spider mites. Both of these pests thrive in dry conditions, which adds additional stress to the peanut plant. *Aspergillus flavus* cannot infect peanuts when soils are kept moist and cool; similarly, spider mites do not generally affect crops that are not under drought stress.

Water availability through irrigation can be extremely important in maintaining a healthy environment free from diseases or insects.

Source: "Texas Peanut Production Guide," Texas A&M University, 1996. http://soil-testing.tamu.edu/publications/751754-747850-B1514.PDF



Diversity in Root Characteristics of Peanut Genotypes

Genotype and Market Type	Taproot Length (in)	Roots at 3-ft (.9-m) Depth (number)	Root Volume (oz)	Root Dry Weight (oz)
Chico (Spanish)	60.6 (154 cm)	1.2	0.7 (.019 L)	.06 (1.7 g)
Florunner (runner)	76.0 (193 cm)	4.9	0.79 (.022 L)	.08 (2.3 g)
PI 355993 (Valencia)	63.8 (162 cm)	3.0	1.09 (.031 L)	.09 (2.6 g)

Source: Melouk, Hassan A. and Frederick M. Shokes, "Peanut Health Management," American Phytopathological Society, 1995.

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

How much irrigation is needed?

When irrigating peanuts, consideration is needed for possible rainfall. Too much water, especially during the maturation stage, can promote plant diseases such as Cylindrocladium black rot, Sclerotinia white mold and leaf blights.

Producers should monitor soil moisture levels and maintain levels at about 85-90% of plant available water holding capacity. If rainfall does occur, this level will permit infiltration and reduce runoff as well as maintain lower disease levels. The amount of supplemental water needed will vary according to soil type, growth stage of the peanut plant, root zone depth, the plant available water when irrigation is begun and the sprinkler efficiency.

Since peanuts are typically grown on sandy loam or loamy sand soils, water management can be crucial. During the germination period, soils should retain 60% plant available water. Irrigating with .3 to .5 inches (.8 to 1 cm) of water will promote more even and vigorous growth. The early vegetative period does not require as much water, and plant available water in the soil can drop to 40%. Irrigating with 1.25 to 2.25 inches (3.18 to 5.72 cm) of water will ensure steady growth. During the nut development/fruiting stage, the addition of .75 to 1.25 inches (1.91 to 3.18 cm) will help maintain flower opening, pegging and pod development. Soil moisture levels should be maintained at 60% of plant available water.

Once the maturation stage is reached, maintain 40% soil moisture levels and apply 1.25 to 2.25 inches (3.18 to 5.72 cm) of water. The actual amount needed will vary by soil type. The use of irrigation provides an important management tool to maintain rapid plant growth and pod development.

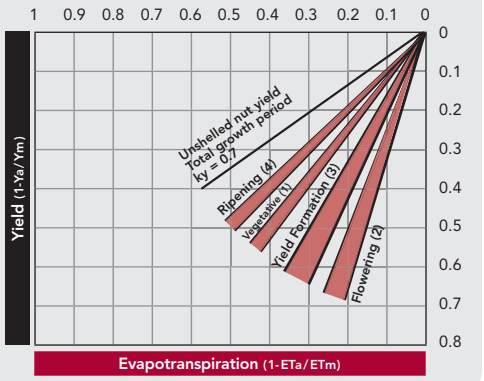
Rainfall alone is usually not adequate and often does not occur at the right time. Studies have shown that yields can be enhanced by 10 to 40% through the use of irrigation, especially during drought years. Split application is more efficient than a single heavy application. The purpose of irrigating is to provide a source of moisture at all critical periods to keep the soils evenly moist. Depending upon rainfall periods alone usually means that the soil becomes excessively dry, then wet, and then dry again. Quality peanuts need a steady supply of water throughout their growth and development.

Irrigation provides the flexibility to maintain the high moisture levels necessary for a successful crop. Keeping the humidity high at flowering, for example, will promote uniform pod set, high yields, and early and uniform maturity. Even during maturation, irrigation is needed to maintain soil moisture levels to mature the peanuts. A light irrigation at harvest may also be beneficial to improve soil conditions for digging peanuts.

EVAPOTRANSPIRATION DEFICIT IMPACT ON PEANUT YIELD

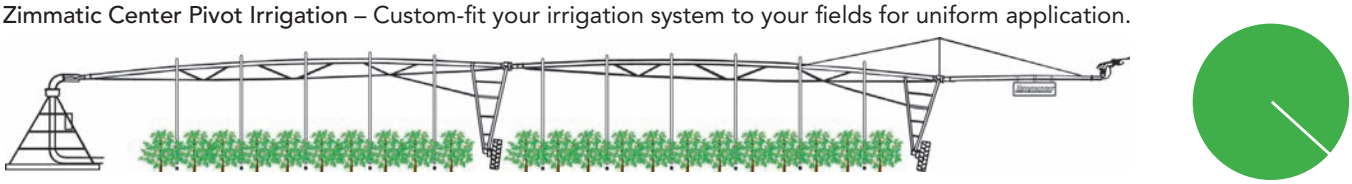
The relationships between relative yield decrease (1 - Ya/Ym) and relative evapotranspiration deficit for the total growing period.

Source: Crop Water Management, AGLW Water Management Group http://www.fao.org/landandwater/aglw/cropwater/groundnut.stm

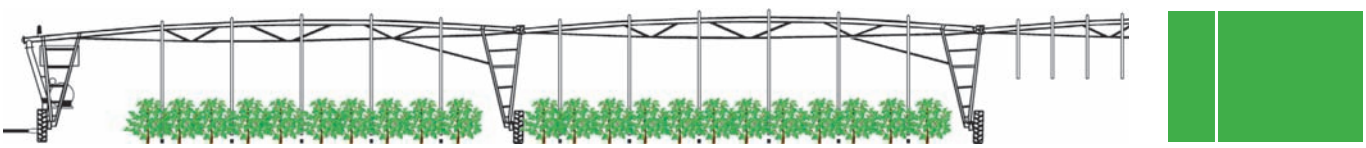


EFFICIENT APPLICATION FOR HIGHER YIELDS

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.



Which system to choose?

Irrigation systems have greatly improved during the past 20 years. Systems most commonly in use today include center pivot, pivot with corner, linear or lateral move and big gun. Most producers prefer some type of center pivot or lateral move compared to gun irrigation. Mechanical move systems provide more even coverage with more efficient applications than high-pressure guns.

WHEN DETERMINING THE SYSTEM FOR YOUR PEANUTS, CONSIDER THE FOLLOWING:

1. Peak crop water requirements and timing of the applications
2. The effective rooting depth of the crop
3. Texture and infiltration rate of the soil
4. Available water-holding capacity of the soil
5. Pumping capacity of any wells to be used as a primary supply
6. The application rate in relation to the intake rate of the most restrictive soils in the field

IRRIGATION SYSTEM INVESTMENT COMPARISONS

Universities have examined the economic factors for irrigation and made cost comparisons of different systems. A study at North Dakota State University compared several irrigation systems, including center pivot, pivot with corner, lateral move, and big gun. Results of this study are summarized below using a 160-acre (65-ha) field, 100-foot (31-m) deep well near the center of the field, adequate water supply at all times and suitable soils for the system application rate.

As can be seen from these data, the center pivot is the most efficient irrigation system, and the use of a big gun was the least efficient in terms of total operating and ownership costs.

Additionally, gun systems do not provide as even a watering pattern as the mechanical move systems. The center pivot, pivot with corner attachment and lateral move (for rectangular fields) provides the most cost-efficient and economical systems for irrigating all crops.

Lindsay has developed a wide range of irrigation application equipment to meet the needs of peanut farmers who know the benefits of irrigation. Each system is designed for maximum efficiency to save time and labor, while reducing crop production risks and promoting a healthy, abundant peanut crop.

Source: "Texas Peanut Production Guide," Texas A&M University, 1996. http://soil-testing.tamu.edu/publications/751754-747850-B1514.PDF

Comparative Cost of Sprinkler Systems
(square 160 acres [65 ha], 100-foot [31-m] deep well in middle of property)

	Center Pivot ($)	Pivot with Corner ($)	Lateral Move ($)	Big Gun ($)
Number of Systems Required (160 acres/65 ha)	1	1	1	2
Annual Ownership Costs (per acre/.405 ha)	57.81	66.71	69.91	56.91
Capital Costs (per acre/.405 ha)	561.54	644.74	689.87	617.83
Total Annual Operating Costs (per acre/.405 ha)	33.97	35.22	39.29	63.32
Operating and Ownership Costs	91.78	101.93	109.20	120.23

Source: "Selecting A Sprinkler Irrigation System," North Dakota State University, Extension Service, Bulletin AE-91, Revised, 1998. http://ndsuext.nodak.edu/extpubs/ageng/irrigate/ae91w.htm

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

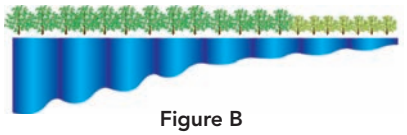


Figure B
Flood irrigation

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 technician can operate as many as 25 pivots. Plus, remote control and monitoring options are available.

Low Energy Precision Application (LEPA) nozzles

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 yields.

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[1]

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

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

Zimmatic center pivot with LEPA on peanuts

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 peanut 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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