

INCREASING ALFALFA AND OTHER FORAGE YIELDS THROUGH EFFICIENT IRRIGATION SOLUTIONS

HIGHER YIELDS... OPTIMUM WATER USE...
LOWER COSTS... PRECISION APPLICATION



Irrigating alfalfa

Alfalfa is one of the most important forage crops grown for hay in the world today, because with ample water, it has the ability to produce high yields of very good quality feed that is high in protein. It is well adapted to a wide range of soils, is relatively drought-tolerant, but also responds well to irrigation. Alfalfa is a high water use crop requiring about 4 to 6 inches of water for each ton (11 to 17 cm per tonne) of dry hay produced. If the water is available, alfalfa will use more water than most other crops because of its long growing season. In many alfalfa growing areas, water is the most limiting factor.

Irrigating alfalfa is different from irrigating annual grain crops because the objective is to produce a high yield of forage and not grain. Some important differences include:

- Alfalfa is a perennial crop with a potentially deep root system that can use water deep within the soil profile.
- Multiple harvests prevent irrigation for about 7 to 10 days per growing cycle.
- Frequent heavy equipment traffic across an alfalfa field causes soil compaction and often forms a

crust on the soil surface.

This crust can result in reduced soil water infiltration rates as stands age resulting in an increased potential of irrigation water runoff.

- Water-logged soils from over-irrigation or too much rain can quickly injure alfalfa plants and encourage weed invasions, especially right after harvest.

Water use efficiency is the greatest during cool to moderate temperatures, especially during spring.

Alfalfa is a deep rooted perennial crop that can use water from deep in a soil profile. Alfalfa roots can penetrate 8 to 12 feet (2.4 to 4 m) deep in a well-drained soil.

However, irrigated alfalfa will obtain 75 to 90% of its water from the upper 4 feet (1.2 m) of soil. Drought stress will cause plant growth to simply slow down or even stop and go dormant if the stress is severe enough. A lack of water at any growth stage will lower the yield, cause the forage quality to peak in fewer days after harvest, and become overly mature faster than under normal conditions.

MANAGEMENT OBJECTIVES FOR IRRIGATED ALFALFA

- Well watered alfalfa will have a light green color which will turn to a darker green color as water stress develops, followed by plant wilting. Wilting will usually start as the soil in the active root zone dries to about 25 to 30% of plant available water. Irrigation should be completed before wilting begins to prevent yield loss. Ideally, the soil water content in the effective root zone should be kept between 50 to 90% to achieve optimum yields.
- Focus on filling the soil profile to a depth of 6 to 8 feet (2 to 2.5 m) with rain and irrigation during the fall and spring periods. The plants can use this water during hot, dry times of the summer when it is very difficult to provide enough water with the irrigation system.
- Light and frequent irrigation is best right after planting to establish the

alfalfa stand. However, following stand establishment, less frequent irrigation of 1 inch (25 mm) or more should be applied. The larger the application amount (up to 3 inches or 75 mm), the better it is at encouraging a good deep root system. Preventing runoff is a must and will be the limiting factor on the amount of water that can be applied with each pass of the pivot. Some producers like to make the first irrigation after harvest fairly light (0.5 inches, 13 mm), so the entire field can be watered quickly to get the growth off to a good start and then start the deeper watering.

- Irrigation should be stopped several days before harvest to allow the soil surface to dry before the equipment enters the field to help prevent soil compaction. Furthermore, irrigation should not begin again before re-growth has started to prevent weeds from germinating.

However, on lower water-holding capacity soils and on lower capacity irrigation systems, watering may need to continue until two or three days before harvest and start again as soon as the hay is removed from the field.

- Irrigation management after harvest needs to be a balance between the facts that if the soil is too dry, regrowth will be slowed and that if the soil is too wet, it will promote weed germination and could damage the alfalfa plants. With this in mind, a good irrigation philosophy is to focus on providing water for the next cutting rather than for the current growth. This strategy should provide adequate water to get regrowth started.

Source: Irmak, S., D.R. Hay, B.E. Anderson, W.L. Kranz, and C.D. Yonts. 2007. Irrigation Management and Crop Characteristics of Alfalfa. NebGuide G1778. University of Nebraska-Lincoln Extension.

Grass and grass legumes mixes

Irrigating grass and grass legume mixes are in many ways very similar to alfalfa. Often the mixtures are produced for grazing, but can also be hayed. Grasses like alfalfa respond very well to irrigation. However, in addition to needing water to produce top yields, grasses need nitrogen.

The nitrogen can all be added through fertilizer or some of the nitrogen can be provided by planting legumes in with the grass. In certain situations, legumes also can improve forage quality and yield. Adding legumes to the mix does have some downsides in that some species can cause bloat when grazed by livestock and increase the management challenges for irrigation, weed control and grazing management.

The correct mix of grasses and legumes is one of the most important aspects of high production from irrigated pasture.

The species that perform well in dryland conditions may not excel in irrigated conditions and vice versa. Usually production will be enhanced if the pasture is reseeded or at least interseeded with additional species. Irrigating species that are poorly adapted to irrigation will never result in top production.

Plants should be:

- Well adapted and tolerant of the climatic, soil, and site conditions
- Capable of producing high forage yields
- Readily consumed by grazing animals and of good nutritional value
- Tolerant of grazing and persistent for a reasonably long pasture life

- Capable of good growth after grazing or haying for sustained season-long production
- Readily established with available equipment
- Compatible with other species within the mix

In summary, the species in a mixture should be similar enough in animal performance to allow management of pasture as a whole, but diverse enough to contribute a range of beneficial traits.

Irrigating these mixes is very similar to alfalfa in many ways. One of the most notable is that they will be grazed every 30 days or so. The harvest cycle will require stopping irrigation to allow the soil to dry down before being grazed. Provisions need to be made for a place to keep the livestock on days when the field is too wet to be grazed.

Source: Volesky, J.D., B.E. Anderson, and J.T. Nichols. 2010. Perennial Forages for Irrigated Pasture. NebGuide G1502. University of Nebraska-Lincoln Extension.



Zimmatic center pivot
with Zimmatic control

Why irrigate?

Zimmatic® by Lindsay irrigation systems brings a cost-effective solution, alleviating risk when the weather isn't cooperating. Water stress affects yield, crop growth, development and quality, as well as decreasing stand life. Inadequate water can also lead to nitrates accumulating in some forage crops.

Feeding this forage can result in nitrate poisoning in livestock.

A Zimmatic irrigation system makes irrigation management easy so yield loss due to crop water stress are minimized and yield per unit of water applied are optimized. The result is a greater return on investment.



SOIL AND IRRIGATION WORK TOGETHER FOR HEALTHY CROPS



Soil drainage is a key factor when determining the crops you plant. Mixtures of legumes and grasses are commonly grown in pastures to extend the grazing season and optimize production, while pure stands of legumes such as alfalfa are commonly grown for hay. In both cases, it is important to know the tolerance of the crop to wet, poorly

drained soils. If these areas cover a significant part of the field, select species that will perform well in the field.

Alfalfa is more sensitive to pH and drainage than grass crops, so alfalfa stands can decline quickly due to root and crown rots if wet soil conditions are present for extended periods.

IMPACT OF SOIL DRAINAGE ON FORAGE SPECIES

Forage Species	Soil Drainage			
	Excellent	Good	Fair to Poor	Very Poor
Alfalfa	[Bar spanning from Excellent to Good]			
Birdsfoot Trefoil	[Bar spanning from Excellent to Fair to Poor]			
Red Clover	[Bar spanning from Excellent to Fair to Poor]			
White Clover	[Bar spanning from Excellent to Fair to Poor]			
Alsike Clover	[Bar spanning from Excellent to Fair to Poor]			
Sweet Clover	[Bar spanning from Excellent to Fair to Poor]			
Bromegrass	[Bar spanning from Excellent to Fair to Poor]			
Timothy	[Bar spanning from Excellent to Fair to Poor]			
Reed Canarygrass	[Bar spanning from Excellent to Very Poor]			
Orchard Grass	[Bar spanning from Excellent to Fair to Poor]			
Perennial Ryegrass	[Bar spanning from Good to Fair to Poor]			
Tall Fescue	[Bar spanning from Excellent to Fair to Poor]			
Meadow Fescue	[Bar spanning from Good to Fair to Poor]			
Creeping Red Fescue	[Bar spanning from Excellent to Fair to Poor]			
Meadow Foxtail	[Bar spanning from Good to Very Poor]			
Kentucky Bluegrass	[Bar spanning from Good to Fair to Poor]			

Source: Ontario Ministry of Agriculture and Food.

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

Monitoring evapotranspiration

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

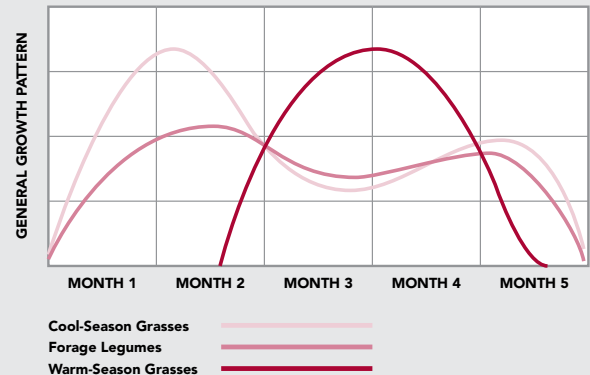
ET rates can range from almost zero on a cool, cloudy, damp day to over 0.5 in/day on a hot, dry, windy day.

To determine when to irrigate, the following information is needed:

1. A local weather station report that estimates reference ET. The reference ET must then be multiplied by the crop coefficient to determine the water use of the crop each day.
2. A rain gauge placed in each field or group of adjacent fields.
3. An estimate of how much water can be used from the soil before irrigation is needed. (This can be calculated by extension agents or crop consultants). To maintain the starting soil water balance, just subtract the crop water use from each day, add in any rain, and apply enough irrigation to balance the equation to the starting point. Over the irrigation season, the balance can be allowed to become negative by the amount of the allowable water depletion for the soil.

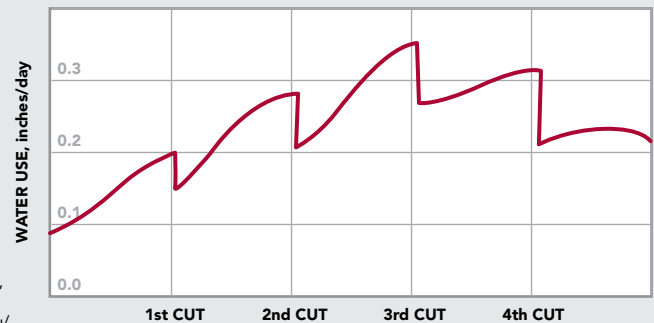
GENERAL GROWTH PATTERNS OF FORAGE CROPS

Source: University of Nebraska, Lincoln; G86-828; <http://ianrpubs.unl.edu/range/g8226.htm>



ALFALFA WATER USE

Source: University of Nebraska, Lincoln; G86-828; <http://ianrpubs.unl.edu/range/g8226.htm>



Alfalfa starts using water in the spring as it begins to grow. Initially, water use is low because of slow growth and cool spring temperatures. As it gets warmer, water requirements increase. The crop reaches maximum ET at the pre-bud stage. Once the crop is cut, water use drops sharply until re-growth begins. This cycle repeats each time the crop is harvested.



9500CC Custom Corner on multiple crops

Why pivots/laterals?

Pivot/lateral irrigation systems – right amount of water at the right time, in the 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.

Improvements in sprinkler design have paralleled those made in mechanical move systems, so Lindsay can provide computer-designed packages tailored to match water application to the specific texture, infiltration rate and holding capacity of the soil.

A center pivot system has low labor requirements, and is available in fixed or mobile versions. It allows forage production on hilly terrain, with slopes up to 15 percent. Sprinklers can be mounted on top of the spans or on drop-tubes to reduce water loss from drift

and evaporation. Available with a choice of drive-motor speeds, center pivots provide the flexibility of using frequent, light watering or more soaking irrigation as forage matures. Adding a corner arm to a center pivot can provide up to 22 acres (8.9 ha) of additional irrigated coverage on a square 160 acre (65 ha) field.

Lateral move irrigation systems can provide up to 98 percent coverage on rectangular fields up to a mile and a half (2.4 km) long. This coverage advantage balances a higher capital investment and makes lateral move systems a frequent choice on high value crops such as forages. Water can be supplied from a ditch, making them ideal for conversion from flood irrigation. Hose-fed systems can be pivoted or towed for use on adjacent fields.

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 field (Figure A), rather than having too much water at the upper end, and not enough water at the lower end of the field (Figure B). You can also control the timing and amount of water that is applied while eliminating runoff, helping to prevent contamination of the water table and nearby streams.

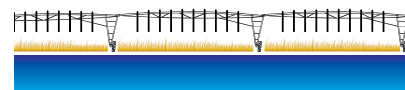


Figure A
Pivot/lateral irrigation

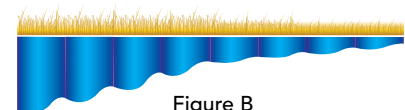


Figure B
Flood irrigation

WHY LINDSAY?

Tough, dependable Lindsay irrigation systems have been the choice of the world's irrigators for more than 55 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.



Machines to fit your field

Zimmatic by Lindsay offers irrigation options like center pivots, lateral moves or 9500CC Custom Corner systems that can handle anything from irregular fields to rugged terrain to multiple crops.



Durability

Heavy-duty spans, trusses and advanced drivelines (Center Drive and AT Gearbox) assure long life, durable operation and 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 Zimmatic control panel offers a different level of control, convenience and maintenance options.

Lower labor costs

The Zimmatic irrigation system is automated, so no one has to move pipes, or open and close floodgates. There are no ditches to maintain for pivots. One person can operate as many as 25 pivots, and with remote control and monitoring options, they can easily do it during the normal work day.

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. 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.

Plus, our systems are designed with your changing needs in mind, allowing for planting flexibility from year to year.

This information should be used as a guide and is not intended to be a guarantee on cost of ownership or yield improvement. Actual results may vary due to soil make-up, water quality, chemigation, fertigation, regional climate, management practices, crop selection, irrigation techniques and marketing.

Zimmatic center pivot

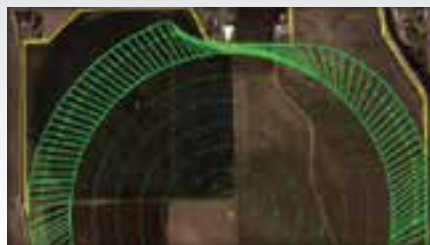


Zimmatic 7500P
small field center pivot



Customized sprinkler packages

Rotating-spray, fixed-spray and medium elevation 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®

Remotely monitor and control entire irrigation systems – from pivots and laterals to pumps and sensors – from a laptop, tablet or smartphone. Next-generation technology provides integrated water, fertilizer and chemigation management.



The Lindsay Advantage

Zimmatic® by Lindsay offers proven systems and products that are built to be strong, long-lasting, durable and easy to use for growers who need highly efficient irrigation solutions. These systems can be enhanced with a family of integrated plug-and-play add-ons.

Growers around the world rely on Zimmatic's innovative technology support by a network of knowledgeable dealers to add value, reduce risk and take full advantage of every growing season.

For more information, visit www.zimmatic.com or talk to your local Zimmatic by Lindsay dealer.



THE LINDSAY ADVANTAGE

DURABLE • RUGGED • EASY TO USE • INTEGRATED TECHNOLOGIES •
BROADEST LINE OF SOLUTIONS



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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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