NSW DEPARTMENT OF
PRIMARY INDUSTRIES

Establishing pastures - Readers' Note

This document is part of a larger publication. The remaining parts and full version of the publication can be found at:

http://www.dpi.nsw.gov.au/agriculture/livestock/dairy-cattle/feed/publications/establishing-pastures

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Irrigation

An irrigation system should apply sufficient water, without waste, at the correct time, to maintain vigorous pasture growth. The best irrigation system is capable of keeping the top 5 cm of soil moist for the first 3 weeks after sowing, and not causing damage to the young seedlings. In the drier, hotter areas where rainfall is low, irrigation design is essential.

There are several different sprinkler irrigation systems available:

Hand-move systems are cheap in capital and running costs, but have a high labour requirement, needing a sprayline shift every 5–6 hours and 1.6 man-hours per hectare.

Side-roll–end-tow: Similar to a hand-move system, this system reduces labour to about 0.5 man-hours per hectare. Suited to flat, rectangular paddocks.

Bike-shift or long lateral: A network of underground pipes, with sprinklers that can be towed by a 4-wheel bike. This system can apply 25 mm of water every 4–6 days. Each sprinkler must be moved twice a day. Ideally suited to odd-shaped paddocks and uneven hilly paddocks.

Travelling irrigators irrigate a rectangular strip. The strip can be 40–100m wide, depending on the size of the sprinkler or boom, and 200–800 m long, depending on the length of hose. This system can apply about 25mm of water in 11 hours. The labour requirement is about 1.5 man-hours per hectare. On young pastures, poor irrigation uniformity due to wind drift, droplet size and the dragging of the hose along the new seedbed can affect germination and seedling vigour. Suited to uneven paddocks.

Centre pivots consist of a single sprinkler lateral supported by a series of towers. The towers are self-propelled, so that the lateral rotates around the pivot point in the centre of the irrigated area. Centre pivot systems are easy to run: when they are set

Irrigation system	Area (ha)	**Capital cost ($/ha)**	Annual costs ($/ha)						Suitability for pasture germination
			Depreciation	Interest	Pumping	Repairs	Labour	**Total**	
Hand-move	25	**1500**	78	128	100	50	120	**476**	good
Powered side-roll	25	**2600**	140	220	110	85	50	**605**	good
Bike-shift	25	**1500**	78	128	80	50	20	**356**	good
Travelling irrigator—soft hose	25	**2400**	125	205	190	90	38	**648**	poor
Travelling irrigator—hard hose	25	**2900**	150	245	190	100	30	**715**	reasonable
Travelling irrigator—fixed boom	25	**3200**	175	270	140	115	40	**740**	poor
Centre pivot	60	**2400**	150	205	75	105	6	**541**	good
Linear move	200	**1325**	90	115	65	65	5	**340**	good

up and operating correctly, very little can go wrong. Their drawback is that the outside sprinklers have to apply high volumes of water because they are irrigating a larger area than the centre sprinklers. Soil water intake rate and soil load-bearing capacity must be taken into account. Water intake rates of at least 10mm an hour are desirable, thus limiting use to light soils.

Linear move: Similar to centre pivot, but self-propelled laterally, making it suitable for rectangular paddocks. Linear moves are hydraulically more efficient and can operate at lower pressure than centre pivots. Tracking problems can occur on heavy soils of poor load-bearing capacity where wheel tracks develop into deep gutters. They require high capital investment but have low irrigation labour requirements. Suited to flat areas with minimal slope.

When to irrigate

The table below describes a number of practical measures to use to determine the best time to irrigate. Simply watering when a pasture is wilted is not good enough; white clover, for example, does not wilt until production has already fallen by 80%.

How much and how often?

This will depend on climate, the soil's capacity to store and release water, the root depth, and the water requirements of the particular pasture species. Water should be applied before the most easily stressed plant or the one with the shallowest root depth wilts.

The maximum amount of water to apply is calculated as:

$$\text{average holding capacity of soil (mm/m)} \times \text{root depth (m)}$$

Soil water status for surface soils and subsoils

Available water	Sands & sandy loams	Loams, clay loams & clays	Comments
Above field capacity	On squeezing, free water is expressed from the ball of soil.	Soil very sticky and sloppy. When squeezed, oozes water.	Soil waterlogged: no air can get to the roots.
100% (field capacity)	No free water appears on the soil when the ball is squeezed but a wet outline is left on the hand.	Soil sticky. No free water appears on the soil when the ball is squeezed but a wet outline is left on the hand. Possible to roll long thin rods 2.5 mm in diameter between finger and thumb.	Plenty of water and enough air available to the plant.
75%	Slightly coherent. Will form a weak ball under pressure but breaks easily.	Soil coherent. Has a slick feeling and ribbons easily. Will not roll into long thin rods 2.5 mm diameter.	Adequate water and air; plant grows well.
50%	Appears dryish. Tends to ball under pressure but seldom holds together. Close to the refill point.	Soil coherent. Forms ball under pressure. Will just ribbon when pressed between finger and thumb. Close to refill point.	Just enough water available to the plant.
25%	Appears dry. Will not ball under pressure.	Somewhat crumbly but will form a ball under pressure. Will not ribbon between finger and thumb.	Past refill point; growth has ceased.
0% (wilting point)	Soil is dry and loose and flows through fingers.	Crumbly–powdery. Small lumps break into powder. Will not ball under pressure.	Desperately needing water; plants will die soon.

For a ryegrass–clover pasture on a clay loam soil with a root depth of 20cm, the maximum irrigation application would be:

$$80 \times 0.2 = 16 \text{ mm}$$

Average available water-holding capacities

Type of soil	Average holding capacity (mm/m)
Sand	25
Fine sand	40
Sandy loam	55
Fine sandy loam	70
Loam	80
Silt loam	90
Light clay loam	90
Clay loam	80
Heavy clay loam	75
Clay	70

Irrigation interval—how often to irrigate—depends on evapotranspiration. This is the amount of water a crop and its soil lose, and is calculated as evaporation × crop factor. Crop factor is the amount of water that a plant transpires as a proportion of free evaporation, and depends on crop and season. The 2 tables below show free evaporation in 4 towns in NSW, and crop factors for 3 crops:

Typical range of effective root depths of species. Actual root depth will depend on soil structure and depth

Species	Root depth (cm)
Clover	15–30
Ryegrass	25–45
Paspalum	30–50
Kikuyu	30–60
Oats	30–60
Lucerne	50–70

Net applications for some pasture species

Species	Sandy loam (mm)	Loam (mm)	Heavy clay loam (mm)
Clover	10–15	10–25	10–20
Ryegrass	15–25	20–40	20–35
Kikuyu	15–30	25–50	25–45
Paspalum	15–30	25–40	25–40
Oats	15–30	25–50	25–40
Lucerne	25–40	40–55	–

Evaporation (mm)

Month	Bega	Richmond	Alstonville	Forbes
January	127	150	180	250
February	102	120	141	175
March	102	100	135	150
April	76	75	107	100
May	51	50	83	60
June	38	40	77	45
July	38	40	88	42
August	43	50	113	60
September	64	75	137	85
October	89	100	158	125
November	127	130	170	160
December	127	140	188	225
Total	984	1070	1577	1477

Crop factor

Crop	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Lucerne	0.95	0.9	0.85	0.8	0.7	0.55	0.55	0.65	0.75	0.85	0.95	1.0
Pasture	0.7	0.7	0.7	0.6	0.5	0.45	0.4	0.45	0.55	0.65	0.7	0.7
Maize	0.7	0.7	0.7							0.7	0.7	0.7

If the evapotranspiration rate is 4mm a day, then the irrigation interval will be:

16mm ÷ 4mm/d = 4 days

Extending the irrigation frequency to 8 days would result in a 50% production loss in the white clover.

The following table gives the irrigation interval for four towns in January:

Town	Daily evap. in January (mm)	Crop factor	Evapotranspiration (mm)	Irrigation interval (days)
Bega	4.10	0.70	2.9	6
Richmond	4.84	0.70	3.4	5
Alstonville	5.81	0.70	4.1	4
Forbes	8.06	0.70	5.6	3