

Perennial Species

Providing benefits for production and the environment in rural landscapes

Most Catchment Action Plans (CAPs) have emphasised the need for increased use of perennial species within agricultural landscapes. The main reasons for this have been environmental, to reduce the infiltration of water through the soil profile and decrease the incidence of dryland salinity. However, by integrating perennial species into the landscape, agricultural systems can also become more profitable and sustainable, improving both the economic and social outcomes for rural regions.

About perennials

Plants are divided into categories according to the length of their life cycle. Perennial plants are long-lived and usually flower every year. Biennial plants complete their lifecycle within two years of germinating and generally do not flower in the first year. While annual plants germinate, grow and set seed in one year

Generally, the longer a plant lives the deeper its roots and the more effectively it can utilise soil water. While annual species are very good at utilising available water while they are growing, because they only live for a portion of the year, the rainfall received out of their growing season can not be used. As well as this, most annuals are shallow rooted and they can only use freely available water near the surface.

Perennial species (including biennials) generally have deeper roots and can survive poor seasons by using various adaptations to control the amount of water that they transpire. This control is achieved in two ways:

- by reducing the leaf area and /or becoming dormant – drought evasion
- by using root storages and /or special leaf surfaces to restrict the use and loss of water while retaining the leaves – drought resistance

In addition to their ability to cope with drought, the survival of plants is also influenced by their physical structure. In many plants the location of growing points allows them to be easily grazed-off. However, many

perennial species, particularly grasses, are more resistant to grazing as the growing points are located at the base of the plant where they are protected, and from which they easily regenerate.

Nevertheless, many perennials are not suited to long-term continuous grazing (set stocking). Managing grazing so that pastures are rested for periods during critical times allows them to replenish root reserves and thereby initiate new buds and shoots.

Environmental benefits of perennials

Perennial plants have developed a range of mechanisms that enable them to survive harsh conditions such as drought and then respond to small rainfall events (see table). In addition to the attributes that reduce water loss, perennials are also able to extract water from a larger volume of soil due to their deep fibrous root system. Many perennials can also extract water from drier soils than annuals. These qualities provide many environmental benefits.

High water use

The water use characteristics of the different plant types are described in the table. Basically, water use has three aspects:

1. Water extraction effectiveness relates to the soil moisture content at which a plant can continue to extract water.

Regional partners:



In comparison to annuals, perennial drought evading plants are better able to extract water from very dry soils whilst drought resistant perennials have an even greater capacity to extract moisture.

2. Water use efficiency (WUE) is the ability of plants to convert water into dry matter (DM). Species with a high WUE produce large amounts of DM/mm of rainfall or available soil moisture. Shorter lived annuals are capable of producing large amounts of DM and therefore have high WUE whilst they are alive. Perennials have a longer growth period than annuals but also may have periods of dormancy and slower growth and therefore their average WUE is usually much lower.

3. Consumptive water use is the percent of the total annual rainfall used by a plant. As perennial plants grow for most of the year and generally have a deep rooting system, they are able to capture most of the rain that falls. In comparison, annuals are in a dormant seed form for long periods and are unable to use rain that falls out of season. Even when annuals are growing, they can not reach water that has percolated below their usually shallow rooting depth. On the other hand, most perennials are able to use the majority of the rain when it falls, or are able to extract water that has moved deep into the sub-soil following big rainfall events.

So, while annuals are effective at converting some stored water and rainfall into DM while they are growing, perennials, because of their longer growing season are able to use more of the total water available.

Prevention of dryland salinity

Dryland salinity occurs when more water than usual enters the subsoil. This creates a rising water table which brings dissolved accumulated salts to the surface. Most arid and semi-arid regions of Australia have high levels of salt in the sub-soil so that excessive leakage of water has the potential to mobilise this salt causing large areas of land to become saline. Salts (mainly sodium chloride) are detrimental to many plants, as they make it difficult for them to extract water from soil. Effectively, salinity produces artificial drought conditions. Plants are unable to use the water that is present and, unless specially adapted, they suffer drought-like effects.

The key to preventing the onset of salinity in dryland areas is to make sure that most of the rainfall is used by plants so as to minimise the water that leaks past the root zone. Annual crops and pastures with high WUE do not have a long enough growing season to use a high enough proportion of the annual rainfall. Including more perennial species is the only known strategy for utilising more rainfall and preventing this form of salinity.

Remediation of dryland salinity

Some perennials have an important role in remediating soils that are already saline. Salt-tolerant species can be grown in and around saline areas to lower the watertable and dry out the soil profile. When the soil is no longer waterlogged, rainfall can leach the surface salts into the sub-soil allowing more salt-sensitive species to grow.

Preventing soil erosion

Soils are susceptible to erosion from both wind and rain when the surface cover is reduced. Annual plant species leave the soil bare for long periods, increasing the threat of erosion. Perennials play an important role because they provide year-long ground cover which reduces erosion by binding the topsoil and reducing surface wind speed. This protective effect also benefits other plants and animals.

Improving our soil

The year-long ground cover that perennials provide is also important for the soil's health. Protection of the soil surface from sunlight and extreme temperatures provides a favourable environment for soil micro-organisms. The plants provide food for micro-organisms which feed on dying roots and in their death the micro-organisms provide nutrients for future plants. In this way perennials contribute to the organic matter of the soil and provide the basis for a microbial ecosystem that will favour the release of soil nutrients in forms that are available for plants.

Improving biodiversity

Native perennial species are fundamentally important in maintaining or improving biodiversity across our landscapes. While this has intrinsic value it may also produce other benefits (e.g. more rapid recovery following drought) although the extent of these benefits is not yet clearly understood.

Production benefits of perennials

Better use of total water

The profitability of grazing enterprises depends on the ability to capture as much of the rainfall as possible and convert it into forage to provide quality feed throughout the year. Perennials can respond to relatively small rainfall events that do not stimulate annuals. Rain water that runs off the soil surface or soaks below the root zone reduces production potential and can have adverse environmental impacts. The inclusion of perennials minimises these losses and provides productive year-round feed for livestock.



Availability of green feed

Perennials have the ability to use water whenever it falls and convert it into green feed. For example, the drought evaders will produce flushes of green feed as a result of summer storms. Drought resisters are even better, as they retain the majority of their leaf, making green feed available even in the driest seasons. Annuals such as soft-seeded varieties of legumes often respond to these false breaks but have high mortalities without sufficient follow-up rain.

Quality feed (high in protein)

Protein levels are maintained in plants while they are green and growing, but their nutrient value will decline once they set seed and approach the end of their growth. Even small quantities of green feed can improve animal production

when most of the available forage is dry. Perennials generally provide a more continuous supply of high protein feed than annuals. Although the digestibility of perennial species may be lower than annuals during active growth it is still sufficient to ensure satisfactory livestock production.

Edibility and palatability

Plants may contain compounds that affect taste (palatability) or alternatively, they may have physical impediments such as spines, thorns, hairs, or simply their height, which reduce their edibility. Perennials are often criticised for being less palatable than annuals. However, highly palatable plants are preferentially grazed by livestock, unless the grazing system is well managed using rotational/strategic systems they will be quickly lost from the pasture. Perennials that are less palatable are often

Comparison of annuals and perennials and their basic attributes

Attributes	Annuals	Perennials	
	Drought avoiders e.g. Wheat, barley grass, wind grass, annual clovers, medics	Drought evaders e.g. Perennial grasses, lucerne, chicory	Drought resisters e.g. Old Man Saltbush, tagasaste, kurrajong, wilga
Physiology and life cycle	Herbaceous plants that flower, set seed and then die in one season.	Grow for more than one year. Form a perennial root mass and rigid stems that can die-back or drop leaves to a woody or resistant butt or crown. Will sprout new shoots, flower and set seed when conditions are favourable.	Grow for more than one year. Mainly woody plants. Specialised leaf surfaces, fine hairs, thick cuticles or specially adapted leaves.
Root depth	Shallow-rooted	Moderately deep-rooted	Deep-rooted
Reproduction	Prolific amounts of seed set in one growing season.	May not set seed in the first season. At maturity, ability to set seed is not great and dependent on climatic conditions. May reproduce vegetatively.	May not reach maturity and set seed in first year. At maturity, ability to set seed is not great and dependent on climatic conditions. May reproduce vegetatively.
Growth rates	Grow quickly	Slow to establish but once mature, growth will recommence quickly after dormancy with new shoots.	Slow to establish but once mature, growth will recommence after dormancy with new shoots.
Drought survival mechanisms	Survive in seed form through inhospitable conditions. Germinate when suitable rainfall occurs. Short periods of water stress can result in major disruption to growth.	Restrict water use by reducing leaf area through shedding and die-back of leaf material. Some cultivars may become dormant under severe moisture stress.	Tolerate water stress periods and restrict water use by shedding some leaf material and reduce transpiration by closing small pores on leaf surfaces. Often have specially adapted leaf surfaces. Can often adjust the sap concentration to assist in extracting water from soil during dry periods.
Water use	Use water effectively while growing but unable to utilise all water available resulting in leakage from the profile.	Generally greater capacity to extract water than annuals, and for longer periods.	Extract small amount of water from a very large volume on a daily basis.
Water extraction effectiveness	Low	Medium to high	High to very high
Water use efficiency (WUE)	High	Medium	Low
Consumptive use (% of annual rainfall used)	Low	Medium	High



desirable as they are able to survive in grazing systems. While their palatability may be reduced, it is important to remember that they are still able to provide high quality feed for livestock.

Persistence and sustainability

Many perennial species are adapted to survive under difficult conditions and they are able to persist for long periods. Persistence is essential as it will ensure the long-term viability of grassland and pasture resources in the landscape. Careful management of perennials during high stress periods (drought) will assist in their long-term survival. Therefore, by incorporating these species into our farming systems and managing them well, we ensure that these systems remain highly sustainable for years to come.

An enhanced environment and farm profitability

Most Australian grasses are perennial and there are also many native perennial forbs, shrubs and trees that can effectively use water. The advantage of native species is that they have developed to cope with the local environment over many centuries. While they are often thought to have low productivity, many can perform as well as exotics when fertilised and mixed with productive legumes. When correctly managed, these species can be encouraged to increase and become a major component of the pasture. Many of these species are already present on many rural properties.

Because native species are well adapted to the Australian climate they tend to persist better during droughts and dry-spells than many introduced species. They are often naturally adapted to acid soils.

Incorporating more perennials into traditional production systems offers advantages in terms of enhanced biodiversity in modified landscapes and reduced water movement below the root zone of annual crops. Additionally, increased production will mean greater profits for farming enterprises, which in turn will result in landholders having more confidence in sustainable agricultural production, a key element for the growth of rural communities.

Managing perennials

There are big differences within and between plant species. For example, not all cultivars of a given species will have the same characteristics, often because they differ in dormancy levels. Therefore, a holistic approach is required to manage perennial species for fodder production. Perennial species need to be managed as an important part of the whole farming system. Often this means recognising the

management needs of perennials by including a system of rotational/tactical grazing with appropriate rest periods to ensure long-term persistence and productivity.

Summary

Many perennials provide extended availability of quality feed for livestock in otherwise dry or drought conditions. If managed well they will remain productive for many years removing the need for costly re-establishment. Perennial species given suitable conditions and management can provide quality feed for the whole year. Perennial species provide more opportunities to achieve favourable environmental outcomes while supporting more profitable agricultural enterprises. The benefits that selected perennials can bring to our farming environment are outlined in the accompanying fact sheets.

For more information

More information can be found in a range of publications including NSW Department of Primary Industries Primefacts and the former NSW Agriculture Agfacts and Agnotes which are available through district offices or directly from the web site: www.dpi.nsw.gov.au

Published by Central West/Lachlan Grain & Graze based on material originally prepared by the 'Perennials Alliance' (NSW Agriculture, Grazing Management Systems and Brian Marshall, Holistic Management® educator) with support from the Natural Heritage Trust.

Grain & Graze Central West/Lachlan is a collaborative research and development program supported by Meat & Livestock Australia, Australian Wool Innovation Limited, Grains Research and Development Corporation and Land & Water Australia in partnership with NSW Department of Primary Industries, NSW Department of Environment and Conservation, Stipa Native Grasses Association Inc., Central West Farming Systems, Central West Conservation Farming Association, Central West and Lachlan Catchment Management Authorities to assist mixed, broadacre farmers to increase farm profit while helping to protect natural resources.

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ISBN 978 0 7347 1793 1

Job number 7551

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