DUAL-PURPOSE CROPS
FACT SHEET

GRDC Grains Research & Development Corporation

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Bolstering feed supply to improve profitability and sustainability

Dual-purpose crops:

- tolerate grazing and can recover to produce a grain or hay crop;
- provide forage to fill the winter feed gap in the livestock cycle; and
- facilitate grazing as a canopy management tool.

Where can dual-purpose crops be used?

Dual-purpose crops are increasingly being used in the high rainfall zones (HRZs) of south-eastern Australia to provide additional winter forage, and there is growing interest in sowing dual-purpose varieties in the drier regions of southern and western Australia.

Grazing winter crops key to mixed-farm profitability

In recent years grazing wheat, barley and triticale in the early stages of development has emerged as a valuable tool to fill winter feed gaps without compromising yield. Vigorous canola varieties are also proving a viable dual-purpose option.

Grazing cereals intended for harvest is not feasible in subtropical regions and is risky in dry regions with poor soil water storage where sufficient water for a strong finish is not assured.

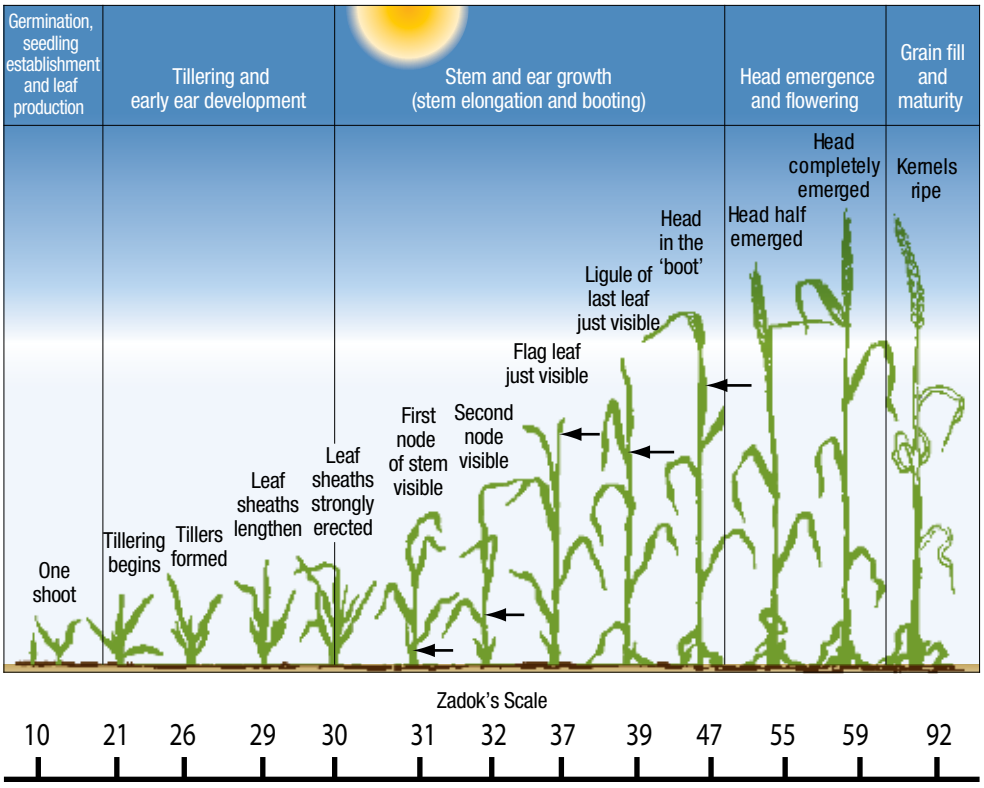
However, in medium to high rainfall zones there is increasing evidence that grazing reduces the amount of water taken up by the crop in its vegetative phase, leaving a reserve in the soil to boost later yields in crops grazed before growth stage 30 (GS30) – a defoliation strategy that represents one of the major pillars of canopy management.

How can dual-purpose crops be used?

There are at least three different ways to use cereal (wheat, barley, triticale, oats, rye) and brassica oilseed (canola) crops for grazing:

1. Sow a crop as a pasture with the sole intention of using it for grazing.
2. Sow a crop with the intention of reaping the grain later (grazing is a bonus).
3. Sow a crop as a pasture with the option of reaping the grain later if late winter/spring conditions permit (grain is a bonus).

FIGURE 1 CEREAL GROWTH STAGES



KEY POINTS

- Grazing dual-purpose crops (cereals and brassica oilseeds) can bolster the winter feed supply
- Crops can be grazed in the early stages of development with minimal effects on grain yield
- Using a whole-farm approach, profitability and sustainability can be improved

PHOTO: BRAD COLLIS

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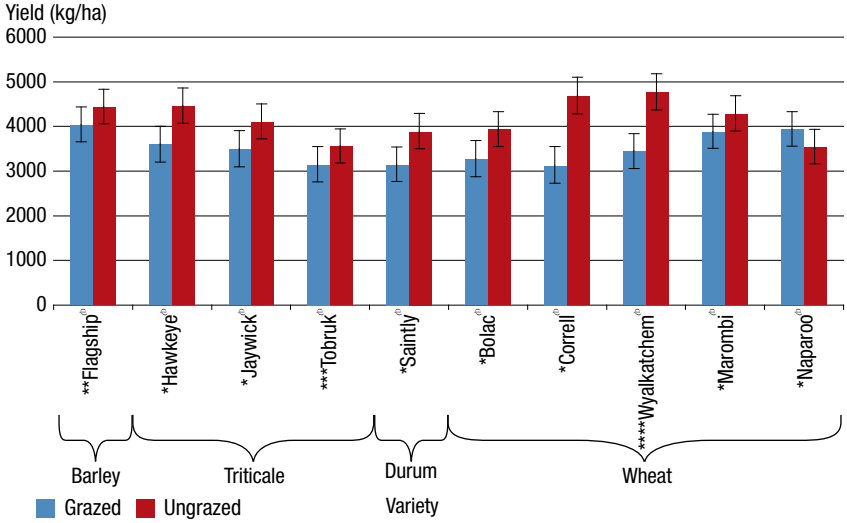
WHAT CROPS CAN BE GRAZED EARLY WITHOUT A NEGATIVE IMPACT ON YIELD?

Trials in the high and medium rainfall zones have consistently shown that intensive grazing (before GS30) of dual-purpose cereals has little or no effect on yield if managed appropriately. Results for shorter-season cereals have been mixed with higher yield penalties occurring in some years. Extensive grazing trials of a wide range of shorter-season varieties and grazing by livestock have not been conducted. Shorter-season varieties reach GS30 rapidly so provide short periods of early grazing. Dual-purpose varieties are later maturing so provide feed over a longer period before reaching GS30. The desired period of grazing needs to be considered when selecting varieties for grazing and grain production.

FIGURE 2 THE EFFECT OF GRAZING ON GRAIN YIELD 2008



* Australian Grain Technologies (AGT) variety ** University of Adelaide variety (Flagship®)
*** University of Sydney variety (Tobruk®) **** InterGrain variety (Wyalkatchem®)
Note: University of Sydney and University of Adelaide varieties have been developed with the assistance of funding from GRDC. GRDC is a shareholder in both AGT and InterGrain.

Figure 2 illustrates the grain yield of barley, triticale and bread wheat varieties after a simulated grazing treatment (multiple mowings) to GS30, as well as the ungrazed control from the mid-north of South Australia in 2008. Shorter-season varieties such as Correll® and Wyalkatchem® tended to experience high yield penalties from grazing compared to winter types such as Marombi® and Naperoo®. Early sowing and earlier maturity due to seasonal conditions may have resulted in greater grain yield penalties.

Data source: Data generated by Jeff Braun and Mick Faulkner, Agrilink Agricultural Consultants Pty Ltd in conjunction with Australian Grain Technologies Pty Ltd.

WHEAT

Longer season or winter wheats are well adapted to early grazing and allow livestock to be removed before crop damage is incurred. Certain early maturing varieties such as Wyalkatchem® can tolerate grazing well if managed appropriately.

Commercially available dual-purpose wheat varieties successfully tested in Australia's southern and western regions (VIC, TAS, NSW, SA and WA) include:

- Amarok® – long-season dual-purpose winter feed wheat;
- Brennan® – dual-purpose white winter feed wheat;
- EGA Wedgetail® – fast-maturing dual-purpose winter wheat;
- Frelon™ – long-season dual-purpose red winter feed wheat;
- Mackellar® – dual-purpose red winter wheat suited to HRZs (VIC, TAS, NSW, SA and WA);
- Marombi® – dual-purpose winter wheat suited to slopes areas;
- Naparoo® – long-season dual-purpose winter wheat;
- Tennant® – dual-purpose winter wheat suited to HRZs (VIC, TAS, southern NSW);
- Whistler – fast-maturing dual-purpose winter wheat; and
- Whylah – fast-maturing long season dual-purpose winter wheat.

BARLEY

Trials have shown that early and intensive grazing pressure in HRZs has no impact on barley grain yield when the seasonal finish is strong. However, as intensive grazing can delay flowering by 5 to 10 days, the crop can be more susceptible to a dry finish.

In the drier regions, the impact of grazing on grain yield can be greater. Seasonal monitoring will determine the probability of rain for sowing, good establishment and early grazing.

Trials have shown that under intensive grazing pressure from two-leaf stage to GS30, Gairdner®, Vlamingh®, Flagship®, Maritime®, Commander® and Fleet® varieties have demonstrated the most consistent yield performance.

Commercially available barley varieties successfully tested in Australia's southern and western regions (VIC, TAS, NSW, SA and WA) include:

- Commander® – high-yielding mid-to-late maturing malting barley suited to medium/HRZs;
- Flagship® – high-yielding malting barley;
- Fleet® – high-yielding malting barley;
- Gairdner® – high-yielding malting barley suited to HRZs and southern medium-rainfall areas;
- Keel – high-yielding, early-flowering, feed-quality barley;
- Maritime® – early-maturing feed barley suited to low/medium-rainfall areas;
- Urambie® – dual-purpose winter variety; and
- Vlamingh® – high-yielding variety.

TRITICALE

Trials have shown that under intensive grazing pressure from two-leaf stage to GS30, triticale varieties deliver high early biomass when compared to most wheat varieties. Jackie has proven the safest dual-purpose variety tested in Australia's southern and western regions (VIC, TAS, NSW, SA and WA), displaying strong early vigour and consistent yield performance. Like the other cereal species, early maturing triticale varieties such as Jaywick® and Hawkeye® can tolerate early grazing if managed well.

CANOLA

Longer-season commercial canola varieties are most suitable for successful dual-purpose use, with minimal impact on yield and oil content if grazing occurs during the vegetative period.

Earlier sowing and grazing increase the risk of blackleg – a severe disease that has caused yield losses exceeding 50 per cent in some seasons.

Canola should be grazed during vegetative growth.

Blackleg can be successfully managed by:

- growing resistant varieties (with a resistance rating of 7.5+);
- avoiding the previous year's stubble; and
- using chemical controls in high-risk situations.

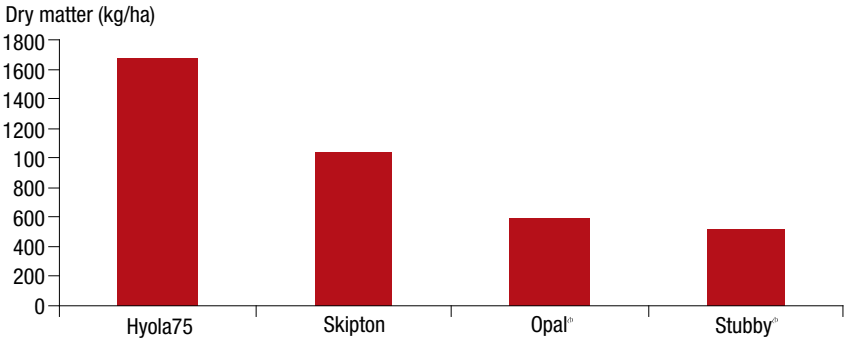
Canola dry matter can rapidly increase after grazing provided conditions are adequate for recovery. The crop is more vulnerable to seasonal circumstances than other crops, which affects seed yield in poor seasons. Selection of appropriate varieties and/or increasing crop density is therefore important.

Grazing during the vegetative stage will delay flowering by about four days. If the main stem is removed by grazing, the crop will recover but yield may be reduced as flowering can be delayed by 14 days.

Hybrid varieties have proven superior in trials conducted throughout southern Australian states, producing up to 50 per cent more biomass at the six-to-eight-leaf stage – when winter grazing commences – than conventional winter varieties, while triazine-tolerant (TT) varieties produce 50 per cent less biomass.

Trials have shown that under intensive grazing pressure from six-leaf stage to budding, hybrid canola varieties including 46Y78 and Hyola 75 have delivered the most consistent yield performance. The conventional variety

FIGURE 3 CROP DRY MATTER AT 79 DAYS AFTER SOWING FOR FOUR CULTIVARS



Crop dry matter at 79 days after sowing for four canola cultivars. This graph shows that early dry matter for grazing can be increased through cultivar selection, with the hybrid (Hyola 75) greatly increasing dry matter available at grazing over conventional and TT cultivars.

SOURCE: *Grazing Canola,* recent results from southern NSW', by Jeff McCormick, Jim Virgona andJohn Kirkegaard, 2008 South Australian GRDC Grains Research Update

Garnet® has also displayed good grain recovery following grazing, while TT varieties such as Marlin® have maintained grain yield but produced less biomass for grazing.

Commercially available canola varieties successfully tested in Australia's southern and western regions (Victoria, Tasmania, New South Wales, South Australia and Western Australia) include:

- Garnet® – mid-season maturing conventional canola variety;
- Hyola 75 – mid-late season maturing hybrid suited to medium/HRZs;
- Pioneer 46Y78 – mid-late season maturing spring hybrid cultivar;
- Pioneer 45Y77 – mid-early season maturing hybrid cultivar;
- Opal® – early season conventional variety;
- Skipton – mid-season conventional variety; and
- Stubby® – early TT variety.

NOTE:

- **Working with an agronomist can help to select varieties that are suitable for your local conditions.**
- If you intend to graze cereals, observe withholding periods for seed treatments, fertiliser treatments and seeding chemicals.

PHOTO: JEFF MCCORMICK

THE BEST OF BOTH WORLDS: BENEFITS OF DUAL-PURPOSE CROPS

- Food wedge – grazing early-sown crops fills the winter stockfeed gap and rests pastures during early growth phases, increasing fodder availability.
- Canopy management – grazing can reduce early biomass by 20 to 30 per cent, delaying maturity and conserving water for late-season grain fill which contributes to potentially higher yields.
- Stability – grazing-induced yield penalties can be compensated by stock liveweight gains.
- Land use efficiency – optimum use of less productive/ degraded land.
- Frost risk management – continuous grazing up to GS30 may delay plant maturity, potentially allowing crops to escape frost events.
- Flexibility – decisions to cut crops for hay or silage can be made mid-season in response to livestock prices or weather conditions.
- Integrated pest management – crop and pasture rotations can improve soil health, disease and pest control.
- Integrated weed management – in paddocks sown using no-till systems, stock graze grass weeds first.
- Stubble management – early season grazing can reduce stubble burdens following harvest.
- Sustainability – early sowing generates greater ground cover and water use efficiency, improving capacity to withstand drought and erosion.
- Efficiency – seasonal income/expenditure, workload and market risks are distributed through different enterprises.
- Cost efficiency – lower relative overheads through economies of scale.

THE TRADE-OFFS: DISADVANTAGES OF DUAL-PURPOSE CROPS

- Livestock trampling/soil compaction and over-grazing stubbles – may compromise soil health.
- Establishment risks – associated with need to sow dual-purpose crops early (higher threat with canola and in marginal rainfall zones).
- Management inefficiency – time and labour requirements for livestock management may conflict with optimal crop management.
- Native pasture destruction, soil erosion and poor yields relative to production costs – caused by cropping unsuitable land.
- Weed and stubble management issues – exacerbated by herbicide withholding periods.
- DISEASE
  - Blackleg – earlier sowing and grazing increases risk in canola crops (use varieties with a resistance rating of 7.5+).
  - Wheat streak mosaic virus – earlier sowing increases risk in wheat crops (implement adequate weed management and mite control; avoid the ‘green bridge’).
  - Root disease – earlier sowing increases the risk of root diseases such as Rhizoctonia and Take-all. Minimise this risk by controlling the ‘green bridge’.
  - Lower returns – when grain and oilseed prices favour cropping over livestock.
  - High resource outlay – dual enterprises require more infrastructure, plant and equipment.

PHOTO: JEFF MCCORMICK

Weighing up the pros and cons

Price ratios determine if benefits to the livestock enterprise from grazing exceed any penalty to the cropping enterprise. The trade-offs that establish whether grazing dual-purpose crops is the best option alter from year to year. Good management may allow more flexible practices that capture increased animal production while minimising yield losses.

Dual-purpose barley Urambie

PHOTO: KELLIE PENFOLD

EFFECTIVE GRAZING MANAGEMENT

The success of dual-purpose crops depends on matching livestock numbers to crop growth so that forage and grain yield are optimised. The profitability of both livestock and grain enterprises needs to be projected to ensure the most profitable enterprise is not penalised.

A feed budget is a useful tool for determining stocking rates and grazing periods, but consideration must also be given to agronomic factors that influence grain yield. These include variety selection, time of sowing, seed rates, weeds, availability of soil moisture and crop nutrition. Herbicide withholding periods also need to be considered when calculating grazing periods.

When to start and finish

Crops should not be grazed until securely anchored in the soil. The pinch and twist test helps identify if crops are anchored. Trials have identified that grazing after key growth stages results in grain yield penalties.

Cereals (wheat, barley, triticale)

Sow early (as soon as temperature and soil moisture allow for successful establishment and early growth). In HRZs it may be possible to graze crops seeded later in the sowing window.

Graze crops as soon as individual plants are 'anchored'.

Remove stock no later than GS30 – the beginning of stem elongation – to allow time for recovery and soil moisture retention for maturity.

A late application of nitrogen can help to optimise grain yields.

Canola

Graze crops during vegetative growth – beginning at the six-to-eight-leaf stage.

Remove stock before buds elongate more than 50 to 100 millimetres above ground to minimise yield losses from defoliation.

Strategies to increase early biomass for grazing include earlier sowing (not too early); varietal choice (hybrid > conventional > TT); increased sowing density; and adequate nitrogen (nutrition).

'PINCH AND TWIST' TEST

To establish when crops are 'anchored', pinch the top canopy leaves between the thumb and the forefinger and pull upwards while twisting the wrist. If the leaves break off and the plant does not pull out of the ground, the crop is ready for grazing.

Stocking rates

To determine optimal stocking rates:

- match stock numbers to dry matter (DM) growth rates using the dry stock equivalent (DSE) rating: 1 DSE consumes 1 kg/ha DM/day to determine how many DSE-days of feed are available;
- then determine the length of the grazing period; and
- the Grazing Winter Cereals Feed Budget Calculator can be downloaded from www.lwa.gov.au/products/PN21197

For successful dual-purpose grazing:

- high stocking densities are preferable to maximise utilisation of crop biomass and ensure even grazing (monitoring will help to minimise trampling damage);
- use temporary fencing and frequently shift stock if livestock numbers are limited; and
- monitor crop development stage and feed availability to ensure grazing does not affect reproductive development.

Nutrients

Cereal and canola fodder quality are extremely high in nutritive value (DM digestibility, protein content) in winter and early spring when dual-purpose grazing is predominantly used.

However, wheat forage is commonly deficient in sodium, marginal for magnesium and high in potassium.

The combination of high potassium and low sodium reduces the absorption of magnesium from the gut, therefore sheep grazing wheat forage should be supplemented with salt and/or magnesium, or growth rates will be sub-optimal.

Forage mineral analyses suggest that mineral supplementation may not be necessary with other cereals or canola.

When dual-purpose is multi-purpose

In addition to grazing dual-purpose crops during late vegetative and early reproductive phases with the intention of producing a grain yield, grain/graze crops can be utilised by livestock in other ways that provide fodder reserves in difficult seasonal conditions. These include:

- sacrificial grazing in mid-to-late reproductive phases when the outlook for a commercial grain harvest is grim (drought);
- conserving crop biomass before harvest when crops can be cut for hay (in early reproductive growth) or whole-crop silage (later in reproductive growth) – an appealing option when fodder in other regions is in short supply;
- grazing mature crops – including grain, stem and leaf matter – to carry other pastures into summer when fodder is sparse; and
- grazing dry crop stubbles or stubble regrowth after harvest.

These options depend on the crop-to-livestock ratio, climate, timing, feed deficiency, and the marginal value of grazing crop fodder. This shows the flexibility of dual-purpose crops.

To graze or not to graze?

Deciding whether to graze, cut or harvest a drought-affected crop is in part determined by yield potential.

Yield probabilities can be calculated using predictive management tools such as Yield Prophet®, which employs the Agricultural Production Systems Simulator (APSIM) model to monitor crops throughout the growing season.

If a crop is running out of plant-available water in poor seasons, it can be cut for hay or heavily grazed.

When below-average rainfall influences variable crop performance and fodder shortages, hay and silage opportunities provide an alternative income that can be more profitable than harvesting.

Hay and silage production are also subject to risks including weather damage and market volatility.

Grain & Graze builds mixed-farm profitability

The ground breaking Grain & Graze program, which evolved from a common vision to improve profitability and sustainability using a whole-farm approach, provides growers with opportunities to spread risks associated with climate variability and fluctuating market prices.

Grain & Graze findings

- Anticipating what the season will be like and having the capacity to alter the crop and livestock ratio accordingly is the key challenge in mixed farming.
- Mixed farms with more livestock are less likely to incur serious financial losses in dry seasons (subject to changes in commodity prices), while those with more cropping can make bigger profits in bumper years.
- Australian producers in higher rainfall areas who grazed cereals under the Grain & Graze program raised profit by as much as 19 per cent.
- Producers in lower rainfall areas who implemented rotational sheep grazing systems under Grain & Graze boosted profit by about three per cent.
- Farmers who adopted or ceased practices based on Grain & Graze recommendations increased profits by nine per cent on average.

Useful resources:

Dr John Kirkegaard, CSIRO Plant Industry	**(02) 6246 5080 Email john.kirkegaard@csiro.au**
Dr Hugh Dove, CSIRO Plant Industry	**(02) 6246 5078 Email hugh.dove@csiro.au**
Jeff Braun, Agrilink Agricultural Consultants Pty Ltd	**Email jeffbraun@bigpond.com**
Grains research update papers	**www. grdc.com.au**
Martin Lovegrove, SARDI (08) 8303 9337	**Email lovegrove.martin@saugov.sa.gov.au**
CSIRO Plant Industry	**www.pi.csiro.au**
Grain & Graze	**www.grainandgraze.com.au**
***Managing Complex Systems* – Preliminary findings from Grain & Graze 2003 to 2008 (2008), Land & Water Australia**	**www.products.grainandgraze.com.au**
***Dual purpose grazing of wheat crops: a cross-regional analysis* (2008), Dr Andrew Moore, CSIRO**	

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