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Productive dual purpose winter wheats

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PADDOCK SELECTION

Soils

Winter wheats do well on a wide range of soil types. Deep well-drained soils are ideal as they maximise the opportunity to store sub soil moisture and allow the crop to explore the maximum available range of moisture and nutrients, provided there are no toxic sub soil restraints to root growth. Early sown wheat crops can root to a depth of two metres, given suitable soil conditions.

Winter wheats can tolerate waterlogging for short periods, although with reduced production. Some triticales tolerate regular waterlogging better than winter wheat and are better suited to these situations (e.g. poorly drained heavy soil paddocks in high rainfall areas, and where drainage is not feasible).

Acid soils

Generally winter wheats perform best where the surface and sub-soil pH is 4.7 or higher, and with little or no soluble aluminium. However, in some districts acid-tolerant varieties can be grown with reasonable success on soils with pH in the top 10 cm down to 4.5, but almost certainly with some yield penalty.

Early sown winter wheats often perform well where surface soil (0–10 cm depth) acidity would normally be a potential problem (e.g. below pH 4.7), but where soil below 10 cm is non acid (low to no aluminium toxicity). Early sowing generally results in fast germination and roots can grow relatively quickly into the non-acid lower soil layers. Wheat varieties vary widely in their tolerance of low pH and aluminium toxicity (see Table 2).

WEED CONTROL

Productive crops, both from a grazing and especially from a grain perspective, require a very high standard of weed control. Otherwise valuable and often scarce moisture, nutrients and sunlight are lost to weeds. A high standard of weed control also removes the hazards of many diseases.

Weed control is a 'numbers' game. Management should aim to reduce numbers and keep them low with an ongoing program. The cornerstone of a good program is to begin weed control in at least the year prior to cropping. For example if the paddock is coming from pasture totally prevent weeds such as ryegrass, from seeding in the spring prior to cropping.

Winter wheat is generally sown on the first late summer/autumn rain event and there is often no chance to control winter weeds prior to sowing. Many winter weeds, such as wild oats, annual ryegrass, thistles and mustards also don't normally begin germinating until well into autumn, long after the crop has been sown.

Good weed control over summer is important to conserve sub soil moisture and can help reduce disease risk. However, summer weed control has little impact on winter weed problems.

Commonly winter wheat is sown as the first crop following a legume pasture phase. Such pastures (often three to 20 years old) generally contain high levels of grass weeds. It is important to remove grasses from the legume pasture mid-winter in at least the year prior to cropping to winter wheat.

Herbicide withholding periods (before grazing)

When planning herbicide weed control programs it is important to check stock withholding period. Some products have a withholding period (before stock can graze the paddock following application) as long as 70 days. Fortunately there often are good alternatives with short withholding periods for many weed problems.

SOWING TIME

If winter wheat is to achieve high winter drymatter production, followed by good grain recovery, it must be sown early. Later sowing results in slow growth, poor total winter production, although grain recovery can still be very good.

Growth rates from early sowing can be as high as 100 kg/ha/DM/day in mid/late autumn when soil moisture is adequate and temperatures are mild. Growth through to the end of grazing typically average 30–60 kg/ha/DM/day, from early sowing, given good moisture, high soil fertility, and sound management. Often pastures at that time of the year grow at 5–10 kg/ha/DM/day. In contrast growth rates from late sowing (e.g. late autumn) are typically 10–20 kg/ha/day (drymatter basis) and even as low as 1.0 kg/ha/day in colder areas. Early sowing can result in running 20–30 dry sheep equivalent per hectare for around three months.

How early to sow depends on the local environment. On the inner slopes the best time to sow is generally late February through March. If conditions are too hot, germination can be poor and early growth adversely affected. For any district the early sowing window generally extends for four to six weeks. The inference could wrongly be that such a period gives a fair amount of sowing time flexibility.

TIMING OPPORTUNITIES

Most areas commonly experience low and erratic rainfall through the desirable sowing time for winter wheats. It is therefore very important to be ready to sow on the first suitable opportunity (i.e. the first feasible rain event) within the desirable sowing 'window'. A missed opportunity to sow in more years than not, results in a missed opportunity of plentiful winter feed from the dual purpose winter wheat crop.

STORING SUB-SOIL MOISTURE

Stored sub-soil moisture is important to increase the probability of successful early sowing and winter wheat survival should a dry autumn follow. The less reliable opening rains are, the more important it is to conserve sub-soil moisture during the fallow period. Some soils are capable of storing more soil moisture than others. Choosing paddocks with soils with good moisture storage capacity, and ensuring they are filled to at least a reasonable level, is important in ensuring a high reliability of winter forage and grain production.

Loamy deep soils are ideal winter wheat paddocks. They can store up to 200 mm of available moisture per metre of soil depth. Every millimetre of stored moisture can be worth 10 to 20 kg/ha of forage DM or/and grain. Stored soil moisture of 150 mm can therefore be worth an additional 3000 kg/ha of DM production, especially in a dry year. Stored moisture can also be vital to grain recovery and therefore grain yield.

CHOOSING VARIETIES

Varieties are chosen on a number of characteristics including climate (rainfall, elevation, temperature), maturity, soil type (especially acidity), grain quality, tolerance to diseases and climate risks (e.g. pre harvest sprouting tolerance of grain), straw strength, head type (bearded, non-bearded), and grazing and grain yield ability. No variety exhibits all the desirable attributes and choice depends on balancing the various risk factors. Some important factors to consider when choosing a variety include;

Maturity

Varieties with later maturity and a longer cold requirement are more suited to areas with longer cold winters (e.g. Monaro). Varieties with quicker maturity and a lower cold requirement have

Table 1. Suggested sowing times for dual purpose grazing and grain (slopes)

	February				March				April			
Weeks	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**
Variety												
Marombi				>	*	*	*	*	*	*	<	<
Rudd, Mackellar, Dennis, Brennan				>	*	*	*	<	<	<		
Wylah, Whistler, Sunsoft 98, Currawong, M5880, Rosella, Pardolate, Lorikeet, Thornbill				>	*	*	*	*	*	*	*	<

> earlier than ideal but acceptable if conditions not too hot

* optimum sowing time

< later than ideal, but acceptable

been released for warmer and lower elevated areas (e.g. slopes districts). A range of varieties between the two contrasting slower and quicker maturing types is available. These tend to best suit the lower tableland/inner slopes areas.

Wet weather tolerance of grain

Red wheats generally have inherent superior grain tolerance to wet weather occurring between when crops are ripe and harvest.

Bearded verse non-bearded

Being non-bearded is advantageous in a dry spring or drought year when crops are grazed out rather than taken through to grain harvest. If a crop is frosted in spring at the head stage non-bearded crops are more suitable should it be fed off or cut for hay or silage. Non-bearded winter wheats are popular as hay wheats.

Other variety features

Many variety attributes help determine which one best suits a given environment. For example in many upper slopes and tableland areas barley yellow dwarf virus can be devastating. Varieties with tolerance and resistance are being released to overcome this disease. There is considerable variety variability to factors such as soil acidity, grain quality, herbicide tolerance, and relative performance.

Brennan * is suited to a wide range of environments including the lower tablelands and the inner slopes. It tends to head 10–15 days earlier than Tennant. It is strong strawed and of medium height.

Dennis * suits the same growing area and sowing time as Brennan. It is of medium height. In some areas its grain yield has been better than Brennan. While sometimes early grazing is slower than Brennan total seasonal grazing production is generally similar.

Mackellar * is the first barley yellow dwarf virus (BYDV) resistant winter wheat to be released. It suits the same growing area and sowing time as Dennis and Brennan.

Lorikeet * is a Rosella replacement with improved stem rust resistance.

Wedgetail * is the only as yet developed southern NSW Prime Hard quality winter wheat. It is bearded with good acid soil tolerance and good tolerance to *Septoria tritici* blotch.

Pardalote * has very good tolerance to acid soils. Its grain yield is similar to Rosella.

Rudd * is a medium height variety with very good resistance to *Septoria tritici*, yellow leaf spot, as well as the three rusts. It has good tolerance to barley yellow dwarf virus (BYDV) and strong straw.

Rosella. While Rosella has been a good variety for a long time, Sunsoft 98 provides improved stem rust resistance and similar yield ability. It is important to investigate market opportunities before growing varieties like Sunsoft 98 or Rosella (in some years a premium is paid to contracted growers).

Marombi has more winter habit than the early-mid season varieties such as Wylah and Whistler, but less than Brennan, Dennis, Mackellar, and Rudd. It suits slopes/inner plains districts and has out-yielded in grain recovery the quicker maturing varieties at several assessment sites. It has good straw strength and is a hard wheat with ASW milling quality. Grazing and grain yields in slopes environments have been very impressive.

Sunsoft 98 * is a stem rust resistant Rosella type suited to the slopes.

Tennant * is suited to the longer season tableland areas. It is the latest maturing currently available variety.

Tennant is the only slower maturing variety with adequate stem rust resistance.

Thornbill * has maturity similar to Rosella, but stem rust resistance is improved.

Whistler * is the quickest of the winter wheats, often being a few days faster heading than Pardalote, Rosella, Sunsoft 98, Thornbill, or Wylah. It has a relatively low 'cold requirement' and has a tendency to begin heading a little prematurely when sown early as a dual-purpose crop.

Wylah * is Australian hard (AH) quality. Similar agronomically to Whistler and Sunsoft 98. It is performing well as a useful dual-purpose wheat on the slopes. Straw strength is reasonable to good. It is also a good variety for grain only sowing from around mid April til the end of May. It has useful tolerance to acid soils.

SOWING RATE

Higher sowing rates generally increase drymatter production, especially in early grazing, generally the first six to 14 weeks after sowing. High sowing rates normally have no negative effect on grain yield or quality.

Suggested sowing rates range from 100 to 120 kg/ha (220 to 240 plants square metre) for colder and higher rainfall areas, 90 kg/ha (160 plants square metre) for medium rainfall areas and milder environments, and 60 kg/ha (120 plants square metre) for lower rainfall warmer districts. These rates are based on good quality seed with a high germination percentage, and an establishment of 80 percent of seed sown.

* indicates a variety protected by Plant Breeder's Rights

Table 2. Characteristics of some current winter wheat varieties

Variety	Maturity	Maximum quality grade and grain colour	Rusts			Septoria tritici blotch	Yellow leaf spot	BYDV resist-ance	Bearded/ no bearded (awns)	Pre-harvest sprout tolerance	Acid soils tolerance	Year registered
			Leaf	Stem	Stripe adult							
Brennan *	mid-late	Feed. W	R	R	R	MR	MS	-	NB	-	-	1998
Currawong	mid-early	Feed. W	MR-MS	R	MR-MS	MR	MR	-	B	S	T	1994
Dennis *	mid-late	Feed. W	R	R	MS	MR	S	-	NB	-	-	1999
Lorikeet*	mid-early	ASW-noodle. W	MS	R	MS	MR	S	-	B	S	Se	2001
Mackellar *	mid-late	Feed. R	R	R	MR	R		R	NB	T	MT	2003
Wedgetail	mid-early	PH. W	MS	R	MR	MR	S	-	B	S	MT	2002
Pardalote *	mid-early	APW-ASW. W	R	R	MR	MR-MS	S	-	B	-	V T	2000
Rosella	mid-early	ASW-noodle. W	MS	MR	MR	MS	MS	-	B	MS	Se	1985
Rudd *	mid-late	Feed. R	R	R	R	R	R	T	NB	T	MT	2002
Marombi	mid	ASW. W	R	R	MR-MS	MS	MR-MS	-	NB	MT	Se	2001
Sunsoft 98*	mid-early	Soft. W	R	R	S	MS	MS	-	B	S	Se	1998
Tennant *	Late	Feed. R	R	R	MR	-	MR	T	NB	VT	-	1998
Thornbill *	mid-early	Bis. W	MR-MS	R	MR-MS	MS	MR-MS	-	B	S	Se	2000
Whistler *	mid-early	ASW. W	MR-MS	R	MR-MS	MR-MS	MR	-	B	S	MT	1998
Wylah *	mid-early	AH. W	MR-MS	R	MR-MS	MR-MS	MR-MS	-	B	S	MT	1999

VT = very tolerant, T = tolerant, MT = moderately tolerant, Mse = moderately sensitive, Se = sensitive, R = resistant, MR = moderately resistant, MS = moderately susceptible, S = susceptible, NB = non-bearded, B =bearded, Bis = biscuit wheat, provided stringent quality requirements met (usually means only growing under contract). W = white grain, R = red grain.

CROP NUTRITION

Productive winter wheat crops require high soil fertility. Fertiliser is almost always required to correct soil deficiencies where high yielding crops are being targeted.

Table 3 indicates the amount of the major nutrients required for a winter wheat crop at various grazing/grain yield levels. While total nutrient requirement is high, a lot is recycled via urine, dung, and trampled plant material rotting back into the soil. However, in the main these will not be re-available for the current crop. Sometimes recycled nutrients, especially dung and urine, will not be evenly re-distributed across a paddock.

Table 3 is for budgeting a crop's nutrient requirements and table 4 is for assessing long term paddock nutrient balances. Nitrogen is generally re-cycled relatively quickly, often well in time for the next crop, but nutrients like phosphorus may re-cycle slowly. Potash and sulphur generally recycle moderately quickly.

The two main elements are nitrogen and phosphorus. Crop response to these is linked; i.e. a crop that is low in phosphorus is unlikely to respond adequately to applied nitrogen. Potash and sulphur are more important to dual-purpose cereal crops and need more careful monitoring than in grain only cereal crops.

Nitrogen

A typical dual-purpose winter wheat crop producing 4000 kg/ha grazing drymatter plus 4000 kg/ha grain will utilise around 220 kg/ha nitrogen. While much of the nitrogen used to produce the grazing will find its way back into the soil (via urine, dung, trampling) most of this will be unavailable for the life of the current crop.

Grazing generally takes up more nitrogen than grain recovery, however commonly nitrogen is running low by the end of grazing, and often before this stage.

In most cases paddocks will need additional nitrogen fertiliser to make up for a soil deficiency

Not all the fertiliser nitrogen needs to be applied at or prior to sowing. Especially in more reliable winter rainfall areas, some can be applied during the growing season. As a season develops nitrogen can be tailored to crop demands (e.g. less in a dry year, more in a wet year).

Table 3. Nutrients required for growing a winter wheat crop

Grazing yield + grain yield		Kgs			
t/ha/drymatter	t/ha/grain	Nitrogen	Phosphorus	Potash	Sulphur
2	2	112	11	44	6.4
2	4	154	16	52	10
2	6	196	22	62	13.6
4	2	182	16	80	9.2
4	4	224	22	88	12.8
4	6	266	27	96	16.4
6	2	252	22	116	12
6	4	294	27	124	15.6
6	6	336	32	132	19.2

Table 4. Nutrient removed by a winter wheat crop

Grazing yield + grain yield		Kgs			
t/ha/drymatter	t/ha/grain	Nitrogen	Phosphorus	Potash	Sulphur
2	2	55	6.8	8.4	3.8
2	4	101	12.8	16.4	6.8
2	6	147	18.8	24.4	9.8
4	2	64	7.6	8.8	4.6
4	4	110	13.6	16.8	7.6
4	6	156	19.6	24.8	10.6
6	2	73	8.4	9.2	5.4
6	4	119	14.4	17.2	8.4
6	6	165	20.4	25.2	11.4

Forty kilograms per hectare nitrogen might once have been considered adequate for a dual-purpose crop where the soil test indicated average nitrogen fertility. However, nutrient budgeting commonly shows 40 kg/ha is not going to go very far to producing the type of crop required. For many medium to lower fertility situations, where crop expectation is high, 100–150 kg/ha nitrogen is more appropriate. While that is an extra cost the returns can be many kg/ha extra beef or lamb, and grain improvements often more than one or two tonnes per hectare.

Phosphorus

The plant takes up almost all of its phosphorus during the early stages of growth (first six weeks). Phosphorus is best supplied at sowing by banding with, or perhaps a portion of it directly below and to the side of the seed. Soil tests are useful for determining phosphorus requirement. Where soils are deficient, as they more than often are, consideration needs to be given to applying 20–30 kg/ha phosphorus.

Sulphur

Sulphur removal in cereal grain only cropping is relatively low and proven instances of deficiency have been few. However, sulphur utilisation in grazing crops is much higher and it is important to consider the soil sulphur status. Soil testing using reliable tests can indicate possible sulphur deficiency. Tissue testing can also assist. Where deficiencies are identified before sowing it is worthwhile considering applying 20 kg/ha sulphate sulphur at sowing. Post germination topdressing with sulphate sulphur can also correct sulphur deficiency, provided reasonable rains follow application to dissolve it and move it into the root zone.

Other nutrients

Potassium and molybdenum are other nutrients that may need to be applied as fertiliser to a winter wheat crop. Soil tests and local professional knowledge can assist in making these decisions. There is little scientific data demonstrating responses by cereals to trace elements.

GRAZING MANAGEMENT

The amount of grazing (calculated on a dry matter basis), the quality of the grazing, the amount of grain, and the quality of the grain, from dual-purpose winter wheats depends on factors such as variety, sowing time, soil type, climate conditions during the season, soil fertility, disease levels, and management.

Winter wheat sown early into good sub soil moisture, with good management, can in typical season's produce 4000 (slopes) to 6000 (tablelands) kg/ha dry matter and 3000–4000 kg/ha grain. This level of grazing is capable of running 25 dse/ha (2.5 beasts/ha) for three (slopes) to five (tablelands) months.

When to graze

Crops can initially be grazed once plants can't be pulled out by stock, or easily pulled out by hand. This is usually when they have developed a secondary root system, which is well-anchored (Zadock growth stage 21–29). Under good growing conditions this will occur six to eight weeks from plant emergence.

However, adequate rainfall is generally required after crop emergence before plants develop a secondary root system that allows them to be well anchored and therefore able to be grazed. The first grazing can therefore sometimes be delayed for some time until a significant rainfall event occurs post emergence, even though the crop may be growing satisfactorily on sub soil moisture.

Grazing quality and liveweight gains

Winter wheats, given good soil fertility, generally exhibit excellent grazing quality. In the vegetative stage protein levels around 20–25 percent (drymatter basis), digestibility levels high at 70–75 percent (drymatter basis), and energy levels high at 10.5–11.2 Mj/kg (drymatter basis) are common. Moisture content of green material is generally 80–85%, good for animal performance. CSIRO research showed lambs on average grew 23% faster on winter wheat (Tennant, Gordon varieties) than on oats (Blackbutt). Farmers regularly claim prime lamb growth rates of up to 320 grams/lamb/day and beef of up to 1.5 kg/day/beast.

Grazing and grain performance can substitute for one another to some degree. For example returns from fattening prime stock may be high, perhaps $2.10/kg liveweight gain, but grain values may be low e.g. $140/t. In such a scenario it may pay a producer to extend the grazing period, even though it is at the expense of grain recovery. Conversely, livestock returns may be low but grain prices high. A restricted grazing period, perhaps no more than two months, can add to grain prospects, especially in a drier year.

DISEASE CONTROL

Winter wheats should be sown as part of an integrated cropping/pasture program to minimise risks from root and crown rot diseases, as well as leaf diseases. Some diseases commonly affecting wheat are listed below.

Root Lesion Nematode

Two species (*Pratylenchus thornei* and *Pratylenchus neglectus*) are common in wheat crops and can cause considerable yield loss. Symptoms are reduced tillering, general ill thrift, and yellowing of lower leaves. Nematodes tend to be worse when continuous cropping with wheat or by rotating with alternative host crops. Nematodes are more widespread then generally appreciated. What species is present, and at what levels, can be detected at specialist laboratories.

Take-All (*Gaeumannomyces graminis var. tritici*)

One of the most devastating root rot diseases. The 'take-all' fungus is carried on plant remains from many grass species. Symptoms include semi circular to circular patches of pre-maturing haying off of plants. The grain is often pinched or fails to form (whiteheads). Yields losses can be devastating.

Barley Yellow Dwarf Virus

BYDV is a serious disease of early sown wheat. It is common on the tablelands/inner slopes, but all areas are vulnerable. Aphids spread BYDV. Early-sown crops are most at risk if infected during the seedling stage. Symptoms include stunting, crop unevenness, numerous infertile ears, and leaf yellowing/reddening. Mackellar is the only resistant variety, although the CSIRO program has promising resistant varieties in trials. Timely control of aphids is critical and is feasible if pests are observed and crops treated before aphids move through a crop. Only choose pesticides registered for the pest and crop situation (check withholding times).

Leaf Rust (*Puccinia recondita*)

Leaf rust is also an important winter wheat disease and can account for yield losses of 30%. Plant breeders have developed varieties with adequate to excellent resistance to the disease.

Septoria tritici blotch (*Mycosphaerella graminicola*)

Septoria is a serious leaf disease of winter wheats. Symptoms include leaf lesions with minute black spots, and leaf death. It is mainly a disease of wet springs and more likely in southern/central areas. A number of varieties have good tolerance to septoria. Fungicide treatments may sometimes be worth considering.

Stem Rust (*Puccinia graminis f.sp. tritici*)

Stem rust has in the past been a devastating wheat disease. A national policy of only growing resistant varieties has largely been successful and has prevented the once regular development of new rust strains (mutations) capable of overpowering resistant varieties.

Stripe Rust (*Puccinia striformis f.sp. tritici*)

Most approved winter wheat varieties have at least adequate resistance. It is a leaf disease that can significantly reduce yield by 30 percent or more. It has the potential to threaten the Australian wheat crop. It is important to only grow varieties with good resistance.

Yellow leaf Spot *(Pyrenophora tritici-repentis*)

Yellow leaf spot can develop in late winter/ early spring following above average rainfall. Symptoms include leaf lesions, often with yellow borders, leaf death, and root stunting. Early sown crops probably avoid root stunting to a greater degree because of the root development before the disease impacts. The disease is mainly associated with retained stubble in a wheat to wheat situation. However, in very wet years disease can be so high that crops become infected regardless of rotation or stubble retention. Many varieties have some tolerance to yellow spot. Fungicides may be a feasible option in very wet years.

ECONOMICS

A common gross margin cost (variable costs) for growing a winter wheat crop is around $250–290/ha. Returns comprise value from grazing plus grain harvest. Typical grazing rates, given good management, can be around 60–100 days at 25 dry sheep equivalents a hectare for slopes districts. Growth rates from lambs and cattle can be quite high. Many farmers have recorded income from grazing of $200–$500/ha. Grain yield following grazing is typically 2.0–5.5 tonnes per hectare, and can be higher in very good years. At prices of $140/t, that equates to gross additional income of $280–$770/ha. Gross margin returns (gross return, less variable costs) therefore vary greatly, but are commonly between $200 and $800/ha, often the most profitable enterprise on the property.

The information contained in this publication is based on knowledge and understanding at the time of writing (May 2005). However, because of advances in knowledge, users are reminded of the need to ensure that information upon which they rely is up-to-date and to check currency of the information with the appropriate officer of New South Wales Department of Agriculture or the user's independent adviser.

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