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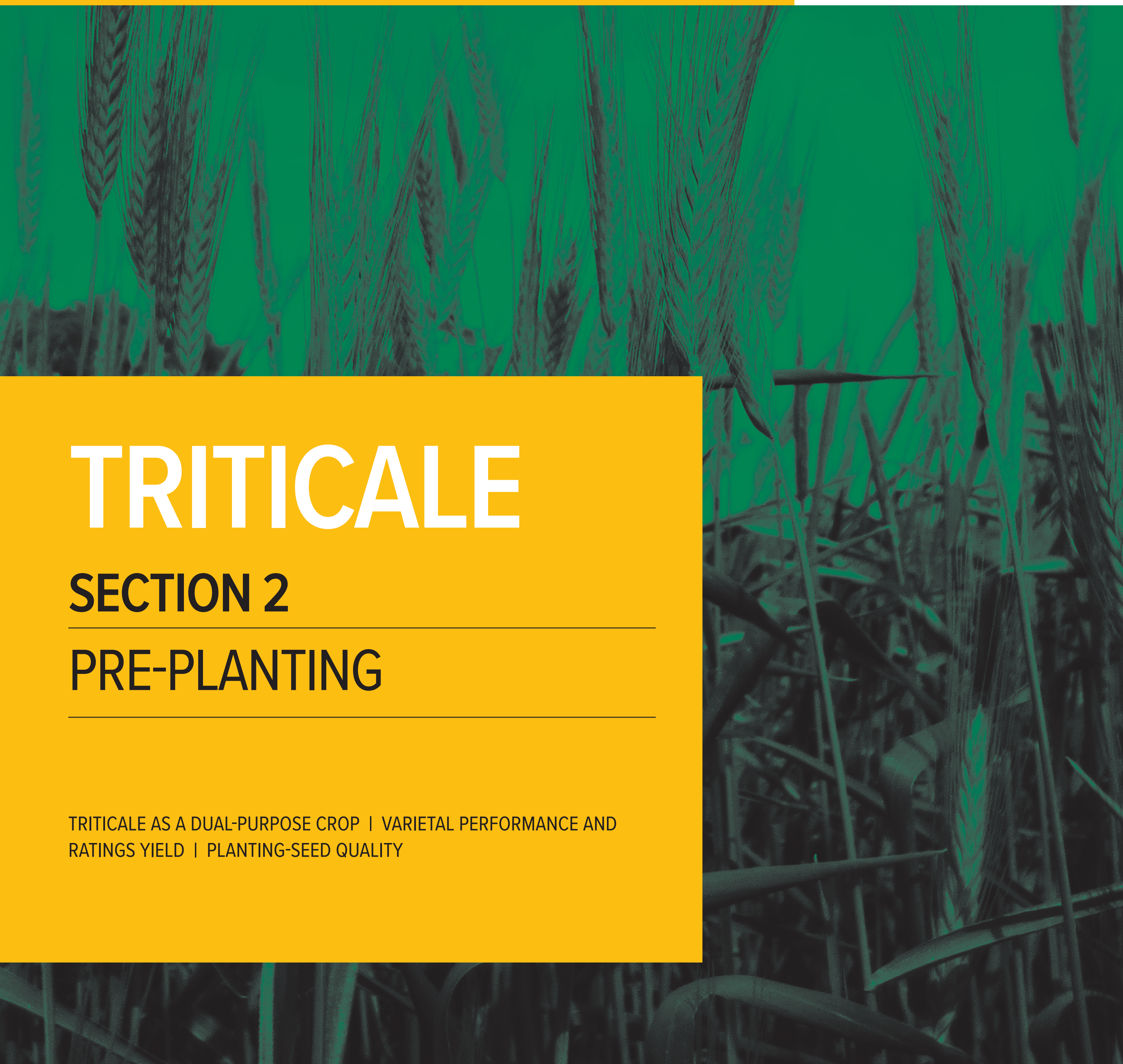

TRITICALE

SECTION 2

PRE-PLANTING

TRITICALE AS A DUAL-PURPOSE CROP | VARIETAL PERFORMANCE AND RATINGS YIELD | PLANTING-SEED QUALITY

Pre-planting

Key messages

- Triticale has good natural vigour through its cereal rye heritage. It has good acid soil tolerance and where lime has not been applied it will out-yield wheat and barley.
- Triticale breeding programs have aimed at improving grain yield and dry-matter production, producing winter triticales with a wider range of sowing dates, improving the grazing habit (having the growing point closer to the ground), and incorporating new sources of rust resistance.
- These breeding programs have produced a number of new varieties designed for particular uses and regions.
- Triticale is extensively used in dual-purpose cropping systems, with varieties bred specifically for them.
- Ensure that seed quality is of a high standard. Check for damage and discoloration because affected seeds may have poor germination and emergence.
- The larger seed size of triticale means that emergence is consistently good; however, high-quality seed must be used.
- Consult local variety sowing guides for the best practices for your region.

Triticale has a niche on farms across Victoria due to several attributes. There are two types of triticale to choose from: grain-only, and dual-purpose (Photo 1). Grain-only varieties perform best in long-season environments rather than in the lower-rainfall regions with an unreliable spring. Dual-purpose varieties can be sown very early, grazed during winter, and then shut up for forage conservation or grain recovery. [1]

Long-season triticales may also be suitable to the Wimmera areas of Victoria and SA for sowing in early to mid-May. [2]

Photo 1: *Triticale combines the high yield potential and good grain quality of wheat with the disease and environmental tolerance of rye.*

2.1 Triticale as a dual-purpose crop

Key points:

- Advantages of dual-purpose crops include minimising risks, capitalising on early rainfall, flexibility in enterprise mix, and improved cash-flow.
- Dual-purpose crops require a high standard of management.

1 Waratah Seed Company (2010) Triticale: planting guide. Waratah Seed Company, http://www.porkcrc.com.au/1A-102_Triticale_Guide_Final_Fact_Sheets.pdf

2 University of Sydney (2012) Triticale. Plant Breeding Institute. University of Sydney, http://sydney.edu.au/agriculture/plant_breeding_institute/key_work_results/triticale.shtml

- Ideal grazing facilities would allow for an excellent water supply, shelter belts and rotational grazing, and drafting cattle into similar weight ranges before being placed onto grazing crops. Try to minimise handling and ensure that all animal health issues are addressed. [3]
- Triticale has excellent grazing and forage values.

Dual-purpose crops hold great potential for farmers to utilise early-season sowing opportunities to provide extra grazing for livestock and yet maintain grain yield. With good management, the period of grazing can increase net crop returns by up to $600/ha, and give a range of system benefits including widening sowing windows, reducing crop height, filling critical feed gaps, and spelling pastures. Over 10 years of experiments, simulation studies and collaborative on-farm validation across Australia have demonstrated that many cereal varieties have the ability to recover after being grazed and go on to produce good crop yields. The combined livestock and crop gross margins can exceed grain-only crops, and increase whole-farm profitability. [4]

The Australian dual-purpose cereal crop (which includes triticale, wheat, oats, barley and cereal rye) is increasing in importance because of factors such as higher-value animal industries. The ability of several recent variety releases to provide valuable winter grazing, as well as a grain yield similar to grain-only crops, helps farmers to improve winter feed supply after pastures have been affected by drought. [5]

When a dual-purpose triticale is grown with the intention of providing winter grazing and then optimising grain production, the time of stock removal or lock-up is important.

2.1.1 Benefits of growing dual-purpose or winter-forage crops

1. Minimises risks

Dual-purpose or winter-forage crops can mitigate the impacts of several natural hazards:

- Weather damage close to grain harvest, which have caused or can cause severe damage to ripening crops.
- Weather damage during the growing period of grazing crops, which can provide irrigation-type benefits.
- Weather damage in November–December, which are not so critical on grazing crops because the benefits have already been banked
- Minimise the risks associated with dry periods in late winter–spring, such as those in 2013, 2014 and 2015.
- Frost
- Yield reductions due to heat shock during flowering

2. Capitalises on early rainfall

- Grazing or dual-purpose crops can be planted in late February and up till late March, thus capitalising on late-summer rain. It also spreads workloads.
- Spreads the sowing window and workloads.
- Early-sown crops will provide quality feed from mid-May in most seasons.

3. Flexibility in enterprise mix

Dual-purpose or winter-forage crops mean that the farm business:

3 K Harris (2016) Dual purpose crops. GRDC Update Paper. GRDC, https://grdc.com.au/Research-and-Development/GRDC-Update-Papers/2016/02/Dual-purpose-crops

4 J Kirkegaard, S Sprague, J Lilley, L Bell L (2016) Managing dual purpose crops to optimise profit from grazing and grain yield north. GRDC Update Paper. GRDC, https://grdc.com.au/Research-and-Development/GRDC-Update-Papers/2016/02/Managing-dual-purpose-crops-to-optimise-profit-from-grazing-and-grain-yield-north

5 GRDC (2007) Dual-purpose crops: Adaptable triticale steps up. Ground Cover. No. 66. GRDC, https://grdc.com.au/Media-Centre/Ground-Cover/Ground-Cover-Issue-66-January-February-2007/Dualpurpose-crops-Adaptable-triticale-steps-up

- Isn't totally vulnerable to fluctuations in grain prices, export markets, grain-quality issues, and downgrading because of weather damage.
- Can tap into the budget profits from weight gains available with buying and selling cattle
- Has the opportunity to 'background' cattle for feedlots and the potential to lock in sale prices at purchase
- Capitalise on cattle prices at feedlots, which are usually higher when grain prices are down—grain is a major input cost for feedlots and therefore it has a major impact on feedlot margins.
- Can delay the decision to lock up dual-purpose crops until late July—during a normal average season when late winter–early spring feed reserves (pastures) are looking good, dual-purpose crops can be locked up, top-dressed, or controlled for weeds if necessary, and kept for grain production.
- Can elect to continue to graze the crop, taking into account cattle and grain prices, levels of stored soil moisture, and the seasonal outlook.

4. Improved cash-flow

- Grazing crops can provide felxibility on both the production and financial side when conditions apply.
- Dual-purpose crops offer the benefit of generating early income from the start of the grazing period.
- Producers don't need to finish the cattle—the best returns are often obtained from backgrounding cattle for local feedlots. A good idea is for growers to speak with the feedlot before they buy cattle; alternatively, there may be an opportunity to background cattle on behalf of a feedlot, being paid for the weight gain only.
- A well-managed forage crop can provide sufficient early-season feed for weaners. Therefore, early income can potentially be paid in August.
- There is no need to wait until December or January (6–8 months) to realise cash-flow.
- For grain recovery in dual-purpose crops in northern areas, growers should budget 50% of un-grazed crops. [6]

MORE INFORMATION

Dual-purpose crops

Optimising grazing and grain yield in dual-purpose crops

Dual purpose crops: do they have a fit in your system and how can they be managed to optimise forage and grain production

2.1.2 When to graze

Dual-purpose varieties can be sown early for winter grazing (30–90 grazing days) and can then be locked up at spring time. The ideal stage to start grazing dual-purpose varieties is when plants are well anchored and the canopy has closed (growth stages GS21–GS29). Do not graze below 5 cm with prostrate varieties and below 10 cm for erect varieties (Photo 2). [7]

In the Southern region, do not graze past Growth stage 31, when the first node on the main shoot is 3-5 cm above the ground. Grazing beyond this growing point can reduce grain yield recovery significantly.

Agronomist's view

6 K Harris (2016) Dual purpose crops. GRDC Update Paper. GRDC, https://grdc.com.au/Research-and-Development/GRDC-Update-Papers/2016/02/Dual-purpose-crops

7 Birchip Cropping Group (2004) Triticale agronomy 2004. Online Farm Trials, http://www.farmtrials.com.au/trial/13801

Continuous grazing is better than rotational grazing for fattening stock. Maintain adequate plant material (1,000–1,500 kg dry matter (DM) per ha) to give continuous and quick regrowth of the crop. The higher grazing height is particularly important with the erect-growing varieties. Over-grazing greatly reduces the plant's ability to recover. [8]

The crop must be monitored regularly (at least twice a week) for stem elongation and the appearance of the first node. This indicates that the plant has gone into reproductive mode and grazing from this time onwards will reduce grain yield. Once the crop reaches this stage grazing should cease. [9]

Photo 2: *Triticale grazed by cattle and used to clean up a paddock.*

Source: EverGraze

MORE INFORMATION

[Yorke Peninsula and Mid-North trials highlight benefits of grain and graze]

[Effect of cutting on early sown triticale and wheat]

In southern trials, grain yields were generally reduced by grazing, possibly because grazing was allowed to continue to about GS31, and is likely to have resulted in the removal of the growing point of the primary tiller, resulting in fewer productive heads. Varieties that produced the highest grain yield when not grazed actually had the greatest yield loss when grazed. Protein content was reduced by grazing in all cereals, and 1,000-grain weight was reduced by grazing in wheat and triticale. As long as farmers stop grazing their cereals before they get to GS30–GS31 they can get a reasonable amount of grazing from the crop, and still realise a good grain yield. It is a matter of farmers trying to get some grazing in winter (when dedicated pastures are growing slowly and under pressure due to low dry-matter levels) and then removing the stock to harvest a reasonable grain yield. [10]

Researchers have found in trials that of four commonly used cereal cover crops (triticale, oats, wheat and barley), triticale produced the highest grain yield following grazing. [11]

8 P Matthews, D McCaffery, L Jenkins (2016) Winter crop variety sowing guide 2016. NSW DPI, http://www.dpi.nsw.gov.au/__data/assets/pdf_file/0011/272945/winter-crop-variety-sowing-guide-2016.pdf

9 Waratah Seed Company (2010) Triticale: planting guide. Waratah Seed Company, http://www.porkcrc.com.au/1A-102_Triticale_Guide_Final_Fact_Sheets.pdf

10 M Roberts (2013) YP and Mid-North trials highlight benefits of grain and graze. Grain and Graze, http://www.grainandgraze3.com.au/resources/343_YPandMidNorthtrialshighlightbenefitsofGG.pdf

11 L Serafin, M Gardner, J Fleming, D Pottie, S Harden (2013) Dual purpose cereals: varieties and management for the northern slopes and plains. GRDC Update paper. GRDC, https://grdc.com.au/Research-and-Development/GRDC-Update-Papers/2013/02/Dual-Purpose-Cereals-Varieties-and-Management-for-the-Northern-Slopes-and-Plains

IN FOCUS

Evaluation of triticale as dual-purpose forage and grain crops

Two cultivars of triticale, Tiga and Empat, were compared with existing commercial cultivars of triticale, cereal rye and forage oats, for grain yield and dry-matter (DM) production. Their performance was evaluated at Armidale, New South Wales, over 3 years, using four regimes: uncut to grain yield, cut in late autumn, cut in autumn and winter, and cut in winter only. Grain yields (up to 4.0 t/ha) of the highest-yielding triticale cultivar (Empat) were equal to, or greater than, the best oats cultivar (Blackbutt). Generally, the highest winter growth rates, dry-matter yield at maturity and grain yield were recorded from uncut plots. Cutting only in autumn had small negative effects on grain yields, but cutting in both autumn and winter reduced total dry-matter yields at maturity by 30%, and grain yields by 50%. Cutting only in winter resulted in higher vegetative forage yields than a double cut (autumn and winter), but the single winter cut subsequently produced lowest dry-matter yields at maturity. The high grain yields of triticale were linked to rapid spring growth. Harvest indices of triticale cultivars were generally lower than those of the oat cultivars. The results indicate the potential of triticale, as a dual-purpose forage and grain crop. [12]

2.1.3 Breeding dual-purpose triticale

Grain producers on the south-western slopes have expressed the importance of dual-purpose triticale varieties, as they want to graze the crop through autumn and winter, and have a subsequent grain crop, to increase their gross margin per hectare and also provide an insurance against harvest failure. Grazing cereals produce twice the amount of dry matter than pastures during the autumn and winter, and also allow pastures to be rested over the winter, thus allowing for better production in the spring. Long-season triticales may also be suitable to the Wimmera areas of Victoria and SA for sowing in early to mid-May.

There can be a high demand for feed grain in these regions, especially for triticale from the dairy and pig industries. The reduced transport costs and the slightly higher price for triticale compared to other feed grains makes triticale an attractive proposition. Triticale is particularly suited to some areas due to its tolerance of acid soils and the high levels of exchangeable aluminium in these soils, especially where the subsoil is acidic and cannot be easily corrected by liming.

Recently the demand for triticale is highly variable. Before making commitments to growing Triticale for grain, growers should assess the market opportunities for their district.

Agronomist's view

With support from the GRDC, the University of Sydney aims to improve the productivity of dual-purpose triticales through plant breeding. This involves improving the grain yield and dry-matter production, producing winter triticales so there is a wider range of sowing dates, improving the grazing habit (so that the growing point

12 AC Andrews, R Wright, PG Simpson, R Jessop, S Reeves, J Wheeler (1991) Evaluation of new cultivars of triticale as dual-purpose forage and grain crops. Animal Production Science, 31 (6), 769–775.

MORE INFORMATION

Dual Purpose Triticale Improvement program

Triticale: grazing guide

is closer to the ground), and incorporating new sources of rust resistance. Shorter triticales are also produced to reduce the amount of stubble after harvest, suiting conservation-tillage farming practices, and also to improve grain yield.

Hybrid triticale is also being developed to increase yield by exploiting heterosis (hybrid vigour), the superiority of the F1 hybrid over the highest-yielding inbred varieties.

The breeding program is also seeking to enhance grain quality, with the aim of improving ruminant productivity on triticale feed. (Grain quality for pigs is being covered by the Pork CRC.) [13]

2.1.4 Triticale grain for livestock

The major uses for triticale grain are as a feed supplement in the dairy industry, as a component in feeds used in beef feedlots, and as a constituent of compound rations for intensive pig and poultry farming. In livestock diets, triticale has a similar role to other cereals (Tables 1 and 2) [14]: it is primarily a good source of energy, as it has a moderate amount of protein and high amounts of starch and other carbohydrates.

A key physical feature of triticale is that it is a soft grain; it has a hardness index almost half that of wheat and barley. This is an advantage in that less mechanical energy is required to mill triticale than wheat and barley prior to inclusion in livestock diets.

Table 1: *Crude protein concentration and yield and% digestible dry matter IVDDM and yield of four grain species harvested at the milk stage of maturity.*

Species	Crude protein		IVDDM*	
	%	T/A	%	T/A
Spring wheat	15.7	0.43	63.3	1.72
Triticale	15.2	0.45	66.4	1.95
Oat	14.6	0.44	61.5	1.86
Barley	15.7	0.50	68.5	2.20

IVDDM = in vitro dry-matter digestibility
Source: Oelke, Oplinger and Brinkman

Table 2: *Forage and diet composition (dry matter basis).*

Item	Alfalfa (%)	Triticale (%)	Oats (%)
Forage			
Dry matter	43.5	37.8	28.0
Crude protein	22.6	17.5	142.0
Neutral detergent fibre	43.8	54.8	52.4
Acid detergent fibre	32.9	32.1	31.1
Calcium	1.69	.56	.42
Phosphorus	.43	.56	.39
Diet			
Dry matter	58.1	52.4	43.7
Crude protein	16.4	17.2	17.3
Neutral detergent fibre	30.3	36.9	36.0
Acid detergent fibre	18.0	19.8	19.3

Source: Oelke, Oplinger and Brinkman

13 University of Sydney (2012) Triticale. Plant Breeding Institute. University of Sydney, http://sydney.edu.au/agriculture/plant_breeding_institute/key_work_results/triticale.shtml

14 EA Oelke, ES Oplinger, MA Brinkman (n.d.) Triticale. In Alternative Field Crops Manual. University of Wisconsin, https://www.hort.purdue.edu/newcrop/afcm/triticale.html

On the farm, triticale can be fed to livestock in the same way wheat or barley would be. [15] It is well suited to feeding dairy cows (Table 3).

The high demand for feed grain for the dairy and pig industries in the Wimmera, the lower transport costs and the slightly higher price for triticale compared to other feed grains, makes triticale an attractive proposition for growers in the southern region. [16]

Table 3: *Effect of forage on milk yield and milk composition.*

Item	Forage source		
	Alfalfa	Triticale	Oats
No. of cows	15	15	12
Milk yield and composition			
3.5% FCM 2 (lb/cow/day)	64.7ab	71.9a	60.7b
fat, %	3.7	3.7	3.9
protein, %	3.4	3.4	3.4
total solids, %	13.3	13.3	13.4

FCM = Fat-corrected milk
ab = Means differ (P 0.05).
Source: Oelke, Oplinger and Brinkman

MORE INFORMATION

Triticale: stock feed guide

A guide to the use of triticale in livestock feeds

How much protein is in triticale grain is thought to depend most on the cultivar, less on the weather conditions of the growth year, and least on nitrogen fertiliser application. [17]

2.1.5 Triticale as a cover crop

A cover crop is planted primarily to manage soil erosion, soil fertility, soil quality, water, weeds, pests, diseases, biodiversity and wildlife in an agro-ecosystem.

Triticale has a heavy residue on the surface, much like that of cereal rye if allowed to reach maturity, making it a good choice for weed suppression. [18]

Triticale is a hardy cover crop that can suppress weeds and produce a moderate to high amount of biomass. Triticale will not produce as much biomass as rye, and may not tie up as much N in the spring.

Triticale is thought to be able reduce soil compaction, loosen topsoil and remove excess soil moisture. [19]

One approach used in southern cropping regions involves annual crops being sown into established lucerne, a practice known as lucerne inter-cropping (Figure 1). [20] The benefits of doing this include reducing the risk of rainfall leakage during the cropping phase, as well as eliminating the costs of lucerne removal and re-establishment.

15 Agriculture Victoria (2012) Growing triticale. Note AG0497. Revised. Agriculture Victoria, http://agriculture.vic.gov.au/agriculture/grains-and-other-crops/crop-production/growing-triticale

16 University of Sydney (2012) Triticale. Plant Breeding Institute. University of Sydney, http://sydney.edu.au/agriculture/plant_breeding_institute/key_work_results/triticale.shtml

17 M Alaru, Ü Laur, E Jaama (2003) Influence of nitrogen and weather conditions on the grain quality of winter triticale. Agronomy Research, 1 (1), 3–10.

18 Advance Cover Crops (n.d.) Triticale. Advance Cover Crops, http://www.advancecovercrops.com/portfolio_item/triticale/

19 Natural Resources Conservation Service (2011) Cover crop : Planting specification guide NH-340. NRCS, http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb1081555.pdf

20 Agriculture Victoria (2015) Farmers' experiences. Agriculture Victoria, http://agriculture.vic.gov.au/agriculture/dairy/pastures-management/managing-dryland-lucerne/farmers-experiences

Under-sowing lucerne

In Victoria, triticale ca be used for inter-cropping with Lucerne. [21] Triticale has poor tillering capacity and good tolerance to shattering. This makes it a useful cereal as a cover crop to establish under-sown lucerne (Photo 3) [22] or medic, although seeding rates may need to be reduced [23] e.g. to approximately 10 to 20% of normal, targeting 15–30 plants per m^2. [24]

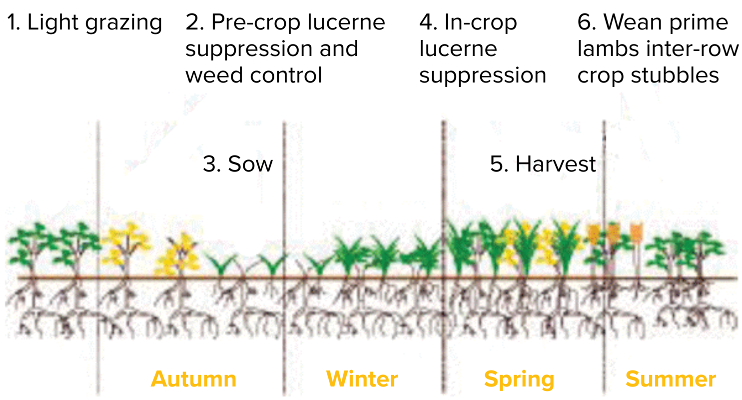

Figure 1: *Lucerne inter-cropping practice.*

Source: Agriculture Victoria

When under-sowing:

- Use a grain-only variety with the earliest available maturity suited to your region
- Sow the triticale at lower seeding rate than used for optimising grain yield
- Choose a paddock with low weed numbers as the combination of species can dramatically reduce herbicide options.
- Expect a reduction in grain yield. [25]

Photo 3: *A paddock of cereal under-sown with lucerne.*

Photos: Andy Howard

MORE INFORMATION

Farmers' experience with lucerne inter-cropping

Break benefits on Mallee soils

21 Agriculture Victoria (2015). Farmers' experiences. Agriculture Victoria, http://agriculture.vic.gov.au/agriculture/dairy/pastures-management/managing-dryland-lucerne/farmers-experiences

22 A Howard (2015) Hubert Charpentier, Brive, France: Lucerne as a living mulch, 4th May 2015. Blog post. Andy Howard's Nuffield Scholarship Journey, https://andyhowardnuffield15.wordpress.com/page/8/

23 Agriculture Victoria (2012) Growing triticale. Note AG0497. Revised. Agriculture Victoria, http://agriculture.vic.gov.au/agriculture/grains-and-other-crops/crop-production/growing-triticale

24 Waratah Seed Company (2010) Triticale: planting guide. Waratah Seed Company, http://www.porkcrc.com.au/1A-102_Triticale_Guide_Final_Fact_Sheets.pdf

25 Waratah Seed Company (2010) Triticale: planting guide. Waratah Seed Company, http://www.porkcrc.com.au/1A-102_Triticale_Guide_Final_Fact_Sheets.pdf

MORE INFORMATION

[Triticale variety sowing guide – 2015]

[Triticale variety trials - 2015]

[Triticale variety trials - 2011]

As far as amount of growth to expect, it is very similar to that of a cereal rye plant, growing 0.9–1.5 m in height. Triticale also has a fibrous root system that makes it an excellent choice for preventing erosion, scavenging for nutrients, and building soil structure.

2.2 Varietal performance and ratings yield

Table 5 gives yield and protein estimates in different parts of the southern region. [26] Growers should be wary when choosing a variety as results can vary year to year. Long term comparisons for triticale varietal performance are yield are limited.

Table 4: *2015 triticale yield (as a percentage of the site mean yield) and protein (%). In all trials except Yarrawonga there were multiple frosts and extreme heat conditions. Interpret data with caution.*

	Yield (%)					Protein (%)				
	Mallee		North East		South West	Mallee		North East		South West
	Ultima	Walpeup	Rutherglen	Yarrawonga	Streatham	Ultima	Walpeup	Rutherglen	Yarrawonga	Streatham
Sowing date	22/5/15	7/5/15	13/5/15	11/5/15	15/5/15					
Astute(D	106	127	93	107	115	12.4	11.3	–	12.5	14.9
Berkshire(D	108	70	107	102	98	13.4	12.4	9.9	14.4	16.2
Bison(D	114	131	106	113	110	12.5	11.2	9.3	13.4	15.5
Bogong(D	99	95	109	108	105	13.1	11.1	9.5	13.2	14.6
Canobolas(D	82	97	97	109	99	13.7	11.7	9.6	14.4	16.2
Chopper(D	112	97	91	104	–	11.9	11.7	9.9	12.7	–
Endeavour(D	–	–	95	92	–	–	–	10.0	13.7	–
Fusion(D	100	99	100	106	116	12.5	11.3	9.4	13.6	14.4
Goanna	102	93	102	95	93	13.3	11.7	9.7	13.4	17.1
Hawkeye(D	95	109	106	91	107	13.4	11.3	9.5	13.6	16.5
Jaywick(D	78	105	98	98	85	14.0	11.6	9.1	13.6	17.3
KM10	83	55	–	–	–	12.4	12.0	–	–	–
Rufus	109	86	90	91	73	12.8	12.7	10.0	14.4	17.0
Tahara	90	96	91	86	94	13.3	12.0	10.1	14.0	15.8
Tuckerbox	–	–	85	86	85	–	–	9.8	12.9	16.4
Yowie	79	102	100	89	93	13.4	11.9	9.5	13.5	15.9
Yukuri	–	–	–	–	74	–	–	–	–	16.0
Site Mean (t/ha)	0.67	1.50	5.86	2.25	3.08					
CV (%)	5	8	7	8	7					
LSD (%)	9	13	12	13	11					

Source: Agriculture Victoria

26 Agriculture Victoria (2016) Triticale [download]. In Victorian winter crop summary. Agriculture Victoria, http://agriculture.vic.gov.au/agriculture/grains-and-other-crops/crop-production/victorian-winter-crop-summary

Table 5: *Agronomic and disease characteristics of triticale varieties.*

Variety	Origin	Purpose	Rainfall zone and environment		Height	Maturity	Head Type	Stripe Rust	CCn Resistance / Tolerance	Pratylenchus neglectus Resistance / Tolerance	Pratylenchus thornei Resistance / Tolerance
Chopperⓓ	SA	Grain	Low rainfall (<375 mm)	Suited to late sowing	S-M	Very E	W/ Awned	MSS	R	-	-
Berkshireⓓ	NSW	Grain			T	E-M	W/ Awned	MS	-	-	-
Bisonⓓ	SA	Dual Purpose			T	E-M	W/ R Awn	MR^	-	-	-
Bogongⓓ	NSW	Grain			M-T	M	W/ Awned	MS	MS / T	-	-
Canobolasⓓ	NSW	Grain			M-T	M	W/ Awned	MSS	-	-	-
Fusionⓓ	SA	Grain			M-T	M	W/ Awned	MSS	R	-	-
Goanna	SA	Grain			T	E-M	W / Awned	MRMS^	R	-	-
Hawkeyeⓓ	SA	Grain			M-T	M	W/ Awned	MR*	R	-	-
KM10	SA	Grain			M-T	E-M	W/ R Awn	MR^	S	-	-
Jaywickⓓ	SA	Grain			M-T	M	W/ Awned	MR*	R	-	-
Rufus	NSW	Dual Purpose			T	M	W/ R Awn	MRMS	R / T	MRR/MT	MRR/MT
Tahara	VIC	Grain			T	M	W/ Awned	MS	R / T	MRR/MT	R / MT
Yowie	SA	Grain			M-T	M	W / Awned	MRMS	R	-	-
Endeavourⓓ	NSW	Dual Purpose	High rainfall (500 mm+)	Suits long season, high rainfall (450 mm+) environments as a grain crop	-	L	W/ R Awn	R	R	-	-
Tuckerbox	SA	Dual Purpose			T	M	W/ R Awn	MR	R	-	-
Yukuri	NSW	Dual Purpose			-	M-L	W/ R Awn	RMR	S	-	-

Height: S = Short, M = Medium, T = Tall.

Maturity: E = Early, M = Mid, L = Late.

Disease resistance: S = Susceptible, MS = Moderately Susceptible, MR = Moderately Resistant, R = Resistant. (*some Susceptible plants in mix, ^limited data

Disease tolerance: T = Tolerant, MT = Moderately Tolerant.

Note that all recommended varieties are MR-R to stem and leaf rust, yellow leaf spot, mildew and scald. All varieties are S to crown rot and MS to common root rot.

Source: PIRSA

2.2.1 Varieties

New: Astuteⓓ

Astuteⓓ is a new, mid-season triticale that is an alternative to Hawkeyeⓓ Bisonⓓ It was bred by AGT (as TSA0466), was first listed in 2015 and was available to growers in 2016. It is a fully-awned variety suited to medium–high-yielding environments, and with excellent agronomic characteristics for grain production. It is rated:

- stem rust—RMR
- stripe rust—RMR#
- leaf rust—RMR

MORE INFORMATION

AGT, Astute⍉

Berkshire⍉ brings home the bacon

Bogong⍉ and Fusion⍉ inseparable in 2014 trials

Bogong⍉ and Canobolas⍉—SA, Vic, NSW

AGT's aim was to produce a very high-yielding triticale which would be the choice for growers looking to maximise the production from their triticale crops in high-potential environments. Astute⍉ combines broad adaptation, resistance to rust and CCN, good physical grain quality, and top-end yield capabilities.

Astute⍉ is suited to high yield potential areas of NSW and Victoria, with a very similar flowering time to Hawkeye⍉ and Fusion⍉.

Berkshire⍉

Berkshire⍉ is a mid-season, awned variety with good straw strength. It is rated:

- stem rust—R
- stripe rust—MRMS#
- leaf rust—R.

This variety has been purpose bred for high yield and feed quality traits for pigs by the University of Sydney and Pork CRC; it was registered in 2009. Its characteristics are:

- Improved ileal digestible energy—13 MJ/kg compared to Tahara at 12 MJ/kg.
- Reduced fibre content—5% to 10% less than Tahara.
- Excellent yield—equivalent to best grain-only varieties currently available.
- Good straw strength.
- Quick to mid-season maturity.
- Moderately resistant to WA and Jackie strains of stripe rust.

New: Bison⍉

An early- to mid-season reduced-awn variety, Bison⍉ is best suited to low–medium-yielding environments. It was intended as a replacement for Rufus. It is rated:

- stem rust—RMR
- stripe rust—R#
- leaf rust—RMR
- CCN—resistant.

Its characteristics are:

- Early-mid maturing, feed quality triticale.
- Tall plant type, with reduced awns and excellent disease resistance.
- Suited to central western NSW, southern NSW, northern Victoria, and SA.
- Moderately resistant to yellow leaf spot, and resistant–moderately resistant to *Septoria tritici* blotch.
- Tolerant to acid soils.

Bogong⍉

Bogong⍉ (tested as H127) was released by the University of New England, Armidale, in 2008. It is a grain variety with early- to mid-season flowering (similar to Treat). It is fully awned and stiff-strawed. It has good resistance to all common field strains of rust. Bogong⍉ has been one of the top-yielding varieties in evaluation trials across all environments in the seven seasons to 2015, up to 15% above Tahara. It is a widely adapted spring variety that is moderately susceptible to CCN. [27]

Canobolas⍉

This is an early- to mid-season awned variety with stiff straw, shorter than Tahara. it was bred by the University of New England, and registered in 2009. It is a widely adapted spring variety and tolerates acid soil. It is rated:

- stem rust—R
- stripe rust—MRMS#

27 C Jeisman (2015) Triticale variety sowing guide 2015. PIRSA, http://www.pir.sa.gov.au/__data/assets/pdf_file/0003/237909/triticale.pdf

MORE INFORMATION

AGT, Chopper⦶

GRDC, Fusion⦶

Ground Cover Radio 110: Triticale program further lifts crop productivity

Goanna

- leaf rust—RMR.

Chopper⦶

Chopper⦶ is an awned, semi-dwarf spring variety which resists lodging in high-yielding environments; it is significantly shorter than all other currently available triticale varieties (15% shorter than Tahara). It matures very early: 3–4 days earlier than Speedee, and 7–15 days earlier than Tahara. It has good grain quality, and performs best in short growing seasons or late-sowing situations. It is rated:

- stem rust—MR
- stripe rust—MRMS#
- leaf rust—R.

The variety was released in 2010.

Fusion⦶

Fusion⦶ is a mid-season variety (similar to Tahara), fully awned, grain-only spring triticale. It has moderate plant height, slightly taller than Hawkeye⦶ and Jaywick⦶, and similar height to Rufus. It yields well in dry or sudden finishes. It is rated:

- stem rust—R
- stripe rust—RMR#
- leaf rust—R
- CCN—resistant.

It was released in 2012. Fusion⦶ produces large grain with low screening losses. Hectolitre weight is similar to that of Hawkeye⦶ and Jaywick⦶, the benchmark varieties for this attribute. Its desirable sowing time is similar to Hawkeye⦶ and Tahara. Fusion⦶ is a fully awned triticale variety. It was released in 2012.

Goanna

Goanna is an early- to mid-season, fully awned, grain-only spring triticale, with a similar heading time to Treat, Tickit, Rufus and Hawkeye⦶ It is a tall, white-chaffed variety. It is rated:

- stem rust—R
- stripe rust—RMR#
- leaf rust—R
- CCN—resistant.

It was released in 2011.

KM10

KM10 is a fast-growing early- to mid-season awned variety. It has excellent early forage production in all rainfall zones. It tends to have a smaller grain, and is ideally suited to grain production in short-season environments. It is rated:

- stem rust—R
- stripe rust—R#
- —leaf rust—MRMS
- CCN—susceptible.

It was released in 2014.

Tahara

A variety that has been widely grown for many years because of its reliability across a range of environments, Tahara is now outclassed by newer options. It may lodge in high-yielding situations. Tahara is suited to most districts with rainfall up to 550 mm. It is rated:

- stem rust—R

- stripe rust—MRMS#
- leaf rust—R
- CCN—resistant
- root-lesion nematode-resistant.

Its resistance makes it a valuable disease-break option. Released 1987 by the Victorian Department of Agriculture, Tahara has long been the benchmark variety for use in cereal rotations in most districts up to 500 mm average annual rainfall.

MORE INFORMATION

Yowie

Endeavour⚶

Yowie

Yowie is a medium to tall mid-season spring grain triticale that has slightly later heading than Tahara. It is fully awned and white-chaffed. It is rated:

- stem rust—R
- stripe rust—MR#
- leaf rust—R
- CCN—resistant.

It was released in 2010, and has shown similar yield performance to other triticale varieties in the National Variety Trials.

Hawkeye⚶

Hawkeye⚶ (tested as TSA0108) was released by AGT in 2007, and is a broadly adapted, mid-maturing variety with high yield potential. It produces large grain with low screenings (similar to Tahara) and good test weight (like Treat), and is considered to be a high-yielding alternative to Tahara. It has CCN resistance, and good resistance to all rusts, making it a good alternative to Kosciuszko.

Jaywick⚶

Jaywick⚶ (tested as TSA0124) was released by AGT in 2007 and is a broadly adapted, mid-maturing variety with high yield potential. It produces large grain with low screenings and good test weight. It is considered a slightly earlier, higher-yielding alternative to Tahara. It has CCN resistance, and moderate to good resistance to all rusts.

2.2.2 Dual-purpose triticales

These varieties can be grazed early and then allowed to produce grain or cut for hay.

Endeavour⚶

Endeavour⚶ is a long-season variety with similar maturity to Breakwell⚶. It is semi-awnless and has good straw strength, with excellent dry-matter production and excellent grain recovery after grazing. It is rated:

- stem rust—R
- stripe rust—RMR#
- leaf rust—R.

It was registered in 2008.

Rufus

Rufus is a mid-season-maturing variety, with a tall growth habit and reduced awns, making it favoured for hay production. Grain yields in higher-rainfall regions have been superior to Tahara, but may also cause lodging. It is rated:

- stem rust—R
- stripe rust—MRMS#
- leaf rust—R
- CCN—resistant.

MORE INFORMATION

[Tobruk⍉](#)

[Triticale trials](#)

It was released in 2005 by the University of New England.

Tobruk⍉

With a strong winter habit Tobruk⍉ is a dual-purpose triticale, or a long-season grain-only variety with excellent grain yield. This variety, which was released in 2007, flowers earlier than Breakwell⍉ and Endeavour⍉. It is rated:

- stem rust—R
- stripe rust—MR#
- leaf rust—R.

Its characteristics are:

- Seedling susceptible, but adult plant resistant to the Jackie strain of stripe rust.
- In some environments, it is affected by stripe rust head infection.
- Strong winter habit.
- Excellent yield after grazing compared to all other varieties in the NSW mixed cereal trials.
- Easy threshing.

Tuckerbox

Tuckerbox is a late-medium season, tall, high-tillering variety. It is a reduced-awn head type, and may be grown for forage or grain. It was released in 2009. It is rated:

- stem rust—MR
- stripe rust—MR#
- leaf rust—R
- CCN—resistant.

Yukuri

Yukuri was bred by the University of New England in 2004, and is a late-medium season variety and a reduced-awn head type. It is suitable for forage and grain production in environments with 450 mm+ rainfall. It has very good rust resistance, but is susceptible to CCN.

As triticale is a minor crop in Australia there is limited long term trial information available about the above vareties from NVT trials across the southern region.

2.3 Planting-seed quality

Before determining seed-sowing rates, seed-germination levels need to be known. For purchased seed this will be stated on the bags supplied. For home-grown seed, the percentage likely to germinate can be simply estimated by moistening the seed in blotting paper on a saucer, and covering with another, inverted saucer. The seed should be kept warm (20°C) and moist for 10 days. After that period, the percentage of seeds that have germinated can be recorded, and used as a guide for planting. Seed with approximately 90% germination or more is suitable for sowing. Seed produced in cooler tableland environments may tend to have poorer germination levels than seed produced in warmer regions, hence the need to check the germination rate. [28]

To receive the most accurate seed germination estimate, a professionally conducted seed test should be conducted by an accredited laboratory.

Heat damage in seeds causes slower germination, delayed emergence of the primary leaf, stunted growth, or even termination of the germination process (Photo 4). [29] In severe cases, seeds may die. During bulk storage, areas of excessive

28 RS Jessop, M Fittler (2009) Appendix 1. Triticale production manual: an aid to improved triticale production and utilisation. In J Roake, R Trethowan, R Jessop, M Fittler, Improved triticale production through breeding and agronomy. Pork CRC, http://www.apri.com.au/1A-102_Final_Research_Report_.pdf

29 Grain SA (2012) Factors affecting wheat seed germination. Grain SA, http://www.grainsa.co.za/factors-affecting-wheat-seed-germination

moisture can lead to the formation of microbe-induced 'hot spots' and since moisture moves from hotter to cooler areas, further local heating is caused, setting off a chain reaction.

Photo 4: *Normal seed (left) compared to heat-damaged seed (right). Note the distinct colour difference.*

Source: Grain SA

Seed impurities can occur from contamination through harvest, storage and machinery. Measurement of seed impurity will be included in a seed-purity certificate. Varieties that have been retained for multiple generations have a greater risk of seed impurity, with the build up of multiple chances for contamination. Ensuring that seed comes from clean, pure and even crops is imperative, and even so seed-purity tests should be carried out. Growers should conduct paddock audits prior to harvest to establish which paddocks best meet these criteria.

With dramatic increases in herbicide resistance, growers need to take seed purity into account when selecting paddocks for seed. This is because ryegrass and black oats now frequently appear in harvested grain samples, and have the potential to infest otherwise clean paddocks. [30]

2.3.1 Seed size

Seed size is an important physical indicator of seed quality that affects vegetative growth and is frequently related to yield, market grade factors and harvest efficiency. A wide array of different effects of seed size has been reported for seed germination, emergence, and related agronomic aspects in many crop species. [31] Generally, large seed has better field performance than small seed. Triticale has the largest seed size of all common small-grained cereal crops (Photo 5). [32]

In triticale, higher germination and emergence has been noted with bigger seed size. Large seeds show a higher emergence potential than smaller seeds (Photo 6). Larger seeds are capable of emerging from greater planting depths and have shown an enhanced ability to penetrate ground cover and survive burial by litter. [33]

30 S Simpfendorfer, A Martin, M Sutherland (2012) Seed impurity undermines stripe rust resistance. 16th Australian Agronomy Conference, http://www.regional.org.au/au/asa/2012/disease/8325_simpfendorfer.htm#TopOfPage

31 DAFWA (2014) Diagnosing poor quality seed in canola. DAFWA, https://www.agric.wa.gov.au/mycrop/diagnosing-poor-quality-seed-canola

32 Agriculture Victoria (2016) Triticale [download]. In Victorian winter crop summary. Agriculture Victoria, http://agriculture.vic.gov.au/agriculture/grains-and-other-crops/crop-production/victorian-winter-crop-summary

33 S Ambika, V Manonmani, G Somasundaram (2014) Review on effect of seed size on seedling vigour and seed yield. Research Journal of Seed Science, 7, 31–38.

Photo 5: *Triticale seed (left) is much larger than wheat seed (right).*

Source: Alberta Agriculture and Forestry

Photo 6: *Plants from small seeds have less vigour and lower yield (right).*

Source: DAFWA

Early researchers of triticale found that plants from larger seed were superior in total germination, seedling dry weight, and in seedling establishment than those from small seed. Large seed of a given cultivar gave 51% higher field stand, 62% more seedling dry weight and 37.8% higher grain yield than plants from small seed. [34] Note that this information is from one trial and may not represent all farm situations. Ultimately, triticale naturally has good early vigour which gives it advantages over wheat and barley and an advantage in adverse soils and seasonal conditions.

Early seedling growth relies on stored energy reserves in the seed. Good seedling establishment is more likely if seed is undamaged, stored correctly, and comes from a plant that had adequate nutrition. Seed should not be kept when it comes from paddocks that were rain-affected at harvest. Seed grading is an effective way to separate good-quality seed of uniform size from small or damaged seeds and

34 UR Bishnoi, VT Sapra (1975) Effect of seed size on seedling growth and yield performances in hexaploid triticale. Cereal Research Communications, 49–60.

other impurities, such as weed seeds. Seed size is also important: the larger the seed, the greater the endosperm and starch reserves. Although size does not alter germination, bigger seeds have faster seedling growth, a higher number of fertile tillers per plant and potentially higher grain yield.

Seed size is usually measured by weighing 1,000 grains, known as the 1000-grain weight. Sowing rate needs to vary according to the 1,000-grain weight for each variety, in each season, in order to achieve desired plant densities. [35] To measure 1,000-grain weights, count out 10 lots of 100 seeds, then combine and weigh the whole lot. When purchasing seed, remember to request the seed-analysis certificate, which includes germination percentage, and the seed weight of each batch where available.

For a seed to emerge successfully from the soil, the seed should never be planted deeper than the coleoptile length. The coleoptile is the pointed, protective sheath that encases the emerging shoot as it grows from the seed to the soil surface (Photo 7). Coleoptile length is an important characteristic to consider when planting a crop, especially in drier seasons when sowing deeper to reach soil moisture. Sowing varieties with short coleoptile lengths too deep can cause poor establishment, because the shoot will emerge from the coleoptile underground and it may never reach the soil surface. [36]

Coleoptile length is influenced by seed size and several other factors, including variety, temperature, low soil water and certain seed dressings, such as those with the active ingredient triadimenol or flutriafol. Trifluralin and several Group B pre-emergent chemicals can also affect coleoptile length. Growers should read the label when using any seed-dressing fungicide for wheat, in order to see what affect it may have on coleoptile length. [37]

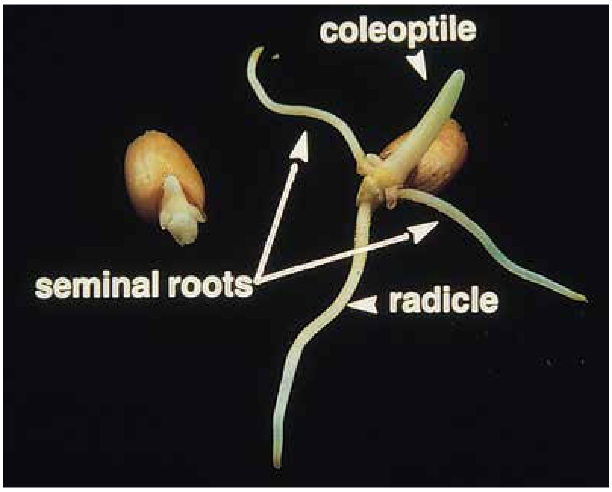

Photo 7: *Coleoptile length is important to consider when sowing seed. Varieties with short coleoptiles cannot be sown deep.*

Photo: David L. Hansen, University of Minnesota

2.3.2 Seed germination and vigour

Seed germination and vigour greatly influence establishment and yield potential. Germination begins when the seed absorbs water, and ends with the appearance of the radicle. It has three phases:

- water absorption (imbibition)

35 NSW DPI District Agronomists (2007) Wheat growth and development. Procrop Series. NSW DPI, http://www.dpi.nsw.gov.au/agriculture/broadacre-crops/winter-crops/wheat,-barley-and-other-winter-cereals/growth-and-development

36 J Pumpa, P Martin, F McCrae, N Coombes (2013) Coleoptile length of wheat varieties. NSW DPI, http://www.dpi.nsw.gov.au/agriculture/broadacre-crops/winter-crops/wheat,-barley-and-other-winter-cereals/coleoptile-length

37 J Pumpa, P Martin, F McCrae, N Coombes (2013) Coleoptile length of wheat varieties. NSW DPI, http://www.dpi.nsw.gov.au/agriculture/broadacre-crops/winter-crops/wheat,-barley-and-other-winter-cereals/coleoptile-length

- activation
- visible germination [38]

Triticale has excellent vigour due to its hybrid characteristics [39], and germination increases with increasing seed size. Seed vigour affects how well the seed or seed lot germinates and emerges. Loss of seed vigour is related to a reduction in the ability of the seeds to carry out all of the physiological functions that allow them to grow well. This process, called physiological ageing (or deterioration), starts before harvest and continues during harvest, processing and storage. Seed performance is progressively reduced due to changes in cell membrane integrity, enzyme activity and protein synthesis. These biochemical changes can occur very quickly (a few days) or more slowly (years), the timescale depending on genetic, production and environmental factors that are not yet fully understood. The end point of this deterioration is death of the seed (i.e. complete loss of germination).

However, seeds lose vigour before they lose the ability to germinate. That is why seed lots that have similarly high germination values can differ in their physiological age (the extent of deterioration) and so differ in vigour and therefore the ability to perform. [40]

For more information on factors affecting germination, see Section 4: Plant growth and physiology.

Grain retained for seed from a wet harvest is more likely to be infected with seed-borne disease. It is also more likely to suffer physical damage during handling, increasing the potential for disease. Seed-borne disease generally cannot be identified from visual inspection, and so requires laboratory testing. [41]

For purchased seed, request a copy of the germination and vigour-analysis certificate from your supplier. For seed stored on the farm, you can send a sample to a laboratory for analysis.

While a laboratory seed test for germination should be carried out before seeding so you can calculate seeding rates, a simple on-farm test can be done in soil at harvest and during storage:

- Use a flat, shallow, seeding tray (about 5 cm deep). Place a sheet of newspaper on the base to cover the drainage holes, and fill with clean sand, potting mix or freely draining soil (Photo 8). [42] Ideally, the test should be done indoors at a temperature of ~20°C or lower.
- Alternatively, lay a well-rinsed plastic milk container on its side and cut a window in it. Place unbleached paper towels or cotton wool in the container, and lay out the seeds on this. Moisten and place on a window-sill. Keep moist, and count the seeds.
- Randomly count out 100 seeds. Do not discard damaged ones, and sow 10 rows of 10 seeds at the correct seeding depth. This can be achieved by placing the seed on the smoothed soil surface and pushing in with a pencil marked to the required depth. Cover with a little more sand or soil and water gently.
- Keep the soil moist but not wet, as overwatering will result in fungal growth and possible rotting.
- After 7–10 days, most of the viable seeds will have emerged.
- Count only the normal, healthy seedlings. If you count 78 normal vigorous seedlings, the germination percentage is 78%.
- Germination of 80% is considered acceptable for cereals.

38 NSW DPI Agronomists (2007) Wheat growth and development. Procrop Series. NSW DPI, http://www.dpi.nsw.gov.au/agriculture/broadacre-crops/winter-crops/wheat,-barley-and-other-winter-cereals/growth-and-development

39 AGF Seeds (2012) Triticale. AGF Seeds, https://agfseeds.com.au/

40 ISTA Vigour Test Committee (1995) Understanding seed vigour. International Seed Testing Association, http://www.seedtest.org/upload/prj/product/UnderstandingSeedVigourPamphlet.pdf

41 GRDC (2011) Saving weather damaged grain for seed, northern and southern regions. Retaining Seed Fact Sheet. GRDC, http://storedgrain.com.au/wp-content/uploads/2013/06/GRDC_FS_RetainingSeed2.pdf

42 P Matthews, D Holding (n.d.) Germination testing and seed rate calculation. Pulse Point 20. NSW DPI, http://www.dpi.nsw.gov.au/__data/assets/pdf_file/0005/157442/pulse-point-20.pdf

- The results from a laboratory seed-germination test should be used for calculating seeding rates. [43]

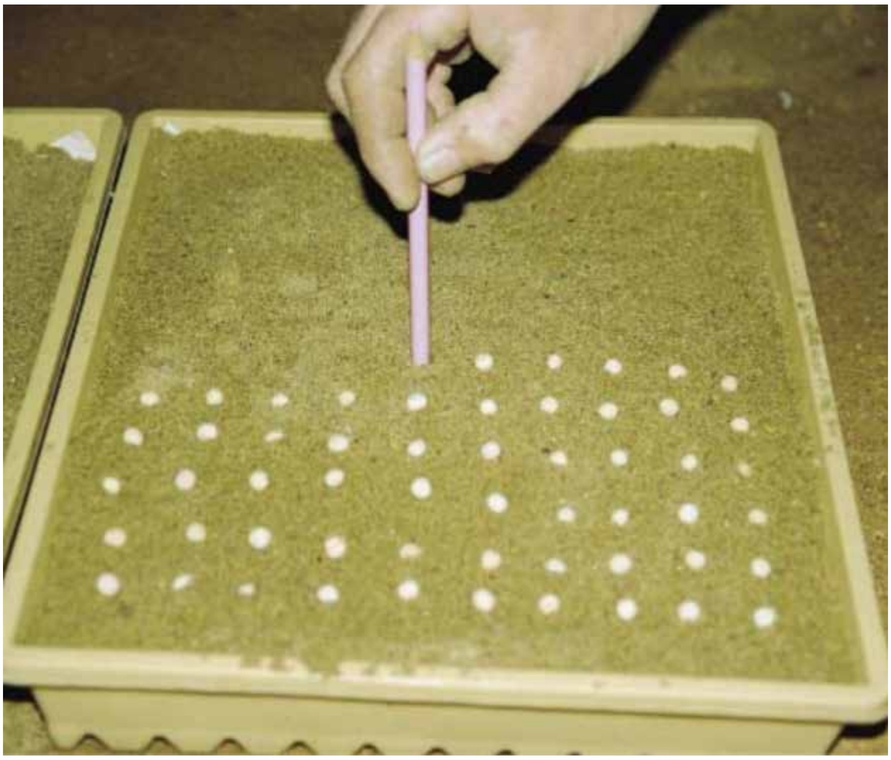

Photo 8: *Use can use a pencil or straw to poke holes in a testing tray.*

Source: NSW DPI

MORE INFORMATION

Germination testing and seed rate calculation

2.3.3 Seed storage

The aim of storage is to preserve the viability of the seed for future sowing and maintain its quality for market. A seed is a living organism that releases moisture as it respires.

Triticale is a softer grain than wheat and barley, which may make it easier to mill for livestock diets, but also means that it is more susceptible to insect damage in long-term storage. [44] The ideal storage conditions are listed below.

- Temperature <15°C (if possible)—high temperatures can quickly reduce seed quality and its ability to germinate. This is why germination and vigour testing prior to planting is so important.
- Moisture control—temperature changes cause air movements inside the silo, carrying moisture to the coolest parts of the seed. Moisture is carried upwards by convection currents in the air; these are created by the temperature difference between the warm seed in the centre of the silo and the cool silo walls, or *vice versa*. Moisture carried into the silo head space may condense and fall back as free water, causing a ring of seed to germinate against the silo wall.
- Aeration slows the rate of deterioration of seed with 12.5–14% moisture content. Aeration markedly reduces grain temperature and evens out temperature differences that cause moisture movement.

43 GRDC (2011) Saving weather damaged grain for seed, northern and southern regions. Retaining Seed Fact Sheet. GRDC, http://storedgrain.com.au/wp-content/uploads/2013/06/GRDC_FS_RetainingSeed2.pdf

44 Waratah Seed Company (2010) Triticale: planting guide. Waratah Seed Company, http://www.porkcrc.com.au/1A-102_Triticale_Guide_Final_Fact_Sheets.pdf

VIDEOS

WATCH: Over the Fence: Insure seed viability with aerated storage

- No pests—a temperature of <15°C stops all major grain insect pests from breeding, arresting activity at all stages of the life cycle so that they cause little or no damage. [45]

For more information, see Section 13: Storage.

45 NSW DPI Agronomists (2007) Wheat growth and development. Procrop Series, NSW DPI, http://www.dpi.nsw.gov.au/__data/assets/pdf_file/0008/516185/Procrop-wheat-growth-and-development.pdf

2.3.4 Safe rates of fertiliser to sow with seed

A productive triticale will require the application of phosphorous (P) and nitrogen (N) at sowing. Additional nitrogen is likely to be required for maximum dry-matter production for grazing and grain yield, particularly if the crop has been grazed.

Consider applying 15–20 kg P/ha at sowing. This is equivalent to 75–100 kg of mono-ammonium phosphate (MAP) per ha, which will also include 7.5–10 kg N/ha. A triticale used for grazing as well as grain production will require significant N. [46]

As with most crops, rates of fertiliser application should be based on soil testing and other historical response information as well as anticipated costs and returns.

Crop species differ in tolerance to N fertiliser applied with the seed at sowing. Research funded by Incitec Pivot Fertilisers has shown that the tolerance is related to the fertiliser product (ammonia potential and osmotic potential), the application rate, row spacing, and equipment used (e.g. disc or tyne), and soil characteristics such as moisture content and texture. [47]

The safest application method for high rates of fertilisers that contain high amounts of ammonium is to place them away from the seed by physical separation (for combined N–phosphorus products) or by pre- or post-plant application (for straight N products). For fertilisers with a lower ammonium content, e.g. MAP, close adherence to the safe rate limits set for the crop species and the soil type is advised.

High rates of N fertiliser applied at planting in contact with, or close to, the seed may severely reduce seedling emergence. If a high rate of N is required, it should be applied before planting, or at planting but not in contact with the seed (i.e. banded between and below sowing rows). Rates should be reduced by 50% for very sandy soil and increased by 30% for heavy-textured soils or if soil-moisture conditions at planting are excellent. [48]

Nitrogen rates should be significantly reduced when using narrow points and press wheels or disc seeders. When moisture conditions are marginal for germination, growers need to reduce N rates if fertiliser is to be placed with, or close to, the seed.

For more information, see Section 5: Nutrition and Fertiliser.

46 Waratah Seed Company (2010) Triticale: planting guide. Waratah Seed Company, http://www.porkcrc.com.au/1A-102_Triticale_Guide_Final_Fact_Sheets.pdf

47 Big N (2014) Nitrogen fertiliser placement and crop establishment. Incitec Pivot Fertilisers, http://bign.com.au/Big%20N%20Benefits/Nitrogen%20Fertiliser%20Placement%20and%20Crop%20Establishment

48 Farmer Community (2014) Guidelines for suggested maximum rates of fertiliser applied with the seed in winter crops. Fertiliser Facts. Incitec Pivot Fertilisers, http://farmercommunity.incitecpivotfertilisers.com.au/Guides%20and%20Publications/Fertiliser%20Facts/Urea