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TRITICALE

SECTION A

INTRODUCTION

CROP OVERVIEW | GROWING REGIONS | HISTORY OF TRITICALE GROWING

Introduction

A.1 Crop overview

Triticale is an established (but minor) cereal crop that combines the productivity of wheat with the hardiness of rye. Triticale (genus X *Triticosecale*) was developed by humans crossing wheat (genus *Triticum*) and rye (genus *Secale*). Its kernels are longer than wheat seeds and are plumper than rye. Its colour can range from the tan of wheat to the grey-brown of rye (Photo 1). Triticale has several advantages in Australian conditions: it is a relatively low-input cereal crop with good disease resistance, particularly to some rusts; it is as high quality a feed grain as wheat; and it is a hardy plant.

It has been developed to incorporate the high yield potential and quality of wheat and the adaptability of rye, and is adapted to a wide range of soil types and environments. Triticale has an aggressive root system that binds light soils better than wheat, barley or oats. Under ideal conditions, researchers have found that triticale can out-yield wheat and barley, and sometimes oats. It can out-yield wheat in several situations: on acid soils, in cool high-rainfall areas, and on low-nutrient soils such as those with low levels of manganese and copper. Triticale is well established as an ingredient in livestock rations.

Photo 1: *Grains of wheat (left), rye (middle) and triticale (right). Note that triticale grain is significantly larger than wheat grain.*

Source: USDA

It is a tall crop bred for strong straw strength which can be useful in rocky paddocks or circumstances where crops have been known to lodge. Its dual-purpose use as grain or forage makes it a useful crop for mixed-enterprise farms.

Triticale in Australia has a spring growth habit, which means it behaves similarly to most cereal crops, maturing in late spring to early summer. Breeding and selection programs have ensured that varieties possess a range of disease and pest characteristics which can compliment disease management for other cereals. It can also carry diseases which may affect other cereal species, e.g. crown rot.

Triticale can be less susceptible to the common fungal diseases of cereals. Some varieties have good resistance to stem, leaf and stripe rusts, mildew and *Septoria tritici* blotch, as well as both resistance and tolerance to cereal cyst nematode.

For more information on triticale variety disease ratings, see Section 9: Diseases, Table 1.

Triticale has poor tillering capacity, but good tolerance to shattering. This makes triticale a useful cereal as a cover crop to establish under-sown lucerne or medic, although seeding rates may need to be reduced. [1]

When added to a cropping sequence, triticale may increase yields of other crops in the rotation and help to reduce costs. Triticale production may also provide environmental benefits, such as erosion control. [2]

Triticale yields more than its ancestors in two types of marginal conditions: in soils where acidity, phosphorus deficiency and foliar diseases are dominant, and in arid and semi-arid zones where drought affects crop production. [3]

Observed traits suggesting higher yields in triticale than wheat include greater early vigour, a longer spike-formation phase with same duration to flowering, reduced tillering, increased remobilisation of carbohydrates to the grain, early vigorous root growth, and more effective transpiration. [4]

Triticale is a mainstream crop in Australia, mostly as spring types grown for grain production, and also as longer-season, dual-purpose types grown for fodder use as hay, silage or grazing followed by grain production.

The grain is primarily used as stock feed, with a low level of triticale use in food products. Most of the grain is used domestically although small amounts are exported.

Triticale usually commands a lower price per tonne than wheat at the farm gate, but holds a similar price to other feed grains. An exception to this can be where there is strong local demand for feed grain, in which case a better cash return with low transport costs could be expected. [5]

The market for triticale is small compared to other cereals as it must compete with barley and sorghum as a preferred feed grain. To combat this, breeders have released better-adapted varieties that have good yield and grain-quality characteristics, with many of the factors identified as the causes of inferior performance having been eliminated. [6]

A.1.1 Triticale for human consumption

Small amounts of triticale are marketed as niche products for human food consumption (Photo 2). Uses include as a flour supplement to wheaten flour for bread, biscuits and cakes, as rolled whole grains for breakfast cereals, as triticale noodles, and in brewing and distilling. Triticale has a distinctive nutty, aromatic and naturally sweet flavour. [7] Triticale as a main cereal for bread making is constrained by variations in bread-making quality, low and inferior gluten content, and lower flour yield. Further, wheat and rye have already been established as the traditional bread cereals and hence consumers' preference for triticale would take some time to change.

MORE INFORMATION

A review of triticale uses and the effect of growth environment on grain quality

Triticale agronomy

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

2 LR Gibson, C Nance, DL Karlen (2005) Nitrogen management of winter triticale. Iowa State University, http://farms.ag.iastate.edu/sites/default/files/NitrogenManagement.pdf

3 M Mergoum, H Gómez-Macpherson (2004) Triticale improvement and production. FAO Plant Production and Protection Paper No. 179. Food and Agriculture Organisation, http://www.fao.org/docrep/009/y5553e/y5553e00.htm

4 S Bassu, S Asseng, R Richards (2011) Yield benefits of triticale traits for wheat under current and future climates. Field Crops Research, 124 (1), 14–24.

5 P Matthews, D McCaffery, L Jenkins (2016) Winter crop variety guide 2016. NSW DPI, https://www.dpi.nsw.gov.au/agriculture/broadacre-crops/guides/publications/winter-crop-variety-sowing-guide

6 Birchip Cropping Group (2004) Triticale agronomy 2005. Online Farm Trials, http://www.farmtrials.com.au/trial/13801

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

Photo 2: *Wholegrain triticale flour (left) and kibbled triticale (right) milled for human consumption.*

Source: Blue Lake Milling

As consumers in general become more health conscious, they are becoming aware of the health benefits of including a broader range of cereal grains in their diets. The greater consumption of grains, together with the current increasing trend in trying novel products, is leading to an increase in consumer interest in baked products, such as breads made using cereal grains other than wheat.

The main culinary uses of triticale are:

- As flour—can be used to make biscuits, rye-type crispbreads, cakes and muffins. The flavour and texture of breads made from triticale are similar to that of light rye bread.
- As flakes—when whole-grain triticale is pressed and rolled, it may be used like rolled oats to make a breakfast cereal or substituted for rolled oats in recipes (e.g. in biscuits and muffins).

The nutritional credentials of whole-grain triticale are:

- It is similar to wheat, with 13% protein, but lower in lysine and niacin.
- It is lower in the protein complex which forms gluten.
- It is a good source of phosphorus and magnesium, and a very good source of manganese.
- It contains B-group vitamins, most notably thiamin and folate. [8]

One study suggested that triticale grain and flour could replace other more commonly used grain to help reduce obesity and diabetes. [9]

Taking these and the agronomic advantages of triticale into account, triticale may have the necessary attributes to become an important food cereal for humans in future. [10]

MORE INFORMATION

Food uses of triticale

A.1.2 Triticale for animal consumption

In livestock diets, triticale has a similar role to other cereals. Triticale is higher in energy than barley and has many desirable nutritional characteristics that suit all classes of livestock. It is primarily an energy source, having moderate protein content with high starch and other carbohydrates.

8 Grains and Legumes Nutrition Council (2016) Triticale. Grains and Legumes Nutrition Council, http://www.glnc.org.au/grains/types-of-grains/triticale/

9 K. Cooper (1985). Triticale food use--Australia. In *Genetics and breeding of triticale: proceedings, 3rd EUCARPIA Meeting, Cereal Section on Triticale, INRA, Station d'Amelioration des Plantes, Clermont-Ferrand, France, 2–5 juillet 1984/[Editors, M. Bernard, S. Bernard].* Paris: Institut National de la Recherche Agronomique, c1985..

10 CM McGoverin, F Snyders, N Muller, W Botes, G Fox, M Manley (2011) A review of triticale uses and the effect of growth environment on grain quality. Journal of the Science of Food and Agriculture, 91 (7), 1155–1165.

The major uses for triticale grain are as a feed supplement in the dairy industry (Photo 3), [11] as a component ingredient in feed used in beef feedlots, and as a constituent of compound rations for intensive livestock (pigs and poultry) rations, where it is a direct substitute for barley or wheat in animal feed rations.

In pig and poultry diets, triticale is equal to or better than wheat or maize in terms of energy value, and superior in terms of protein content and quality. In dairy rations, triticale has an advantage over barley due to its high metabolisable energy, palatability and ease of milling. [12]

Photo 3: *Triticale is often chosen by farmers for stock feed due its high nutritional qualities.*

Source: The Australian Dairyfarmer

A key physical feature of triticale is that it is a soft grain, with a hardness index almost half that observed for wheat and barley. This is an advantage as less mechanical energy is required to mill triticale compared to wheat and barley prior to including it in livestock diets. On the farm, triticale can be fed to livestock in the same way wheat, oats or barley would be fed to stock (Table 1). [13]

Many triticale growing regions correspond with intensive livestock production in Australia making it readily accessible by most feed mills. The reduced transport costs and the slightly higher price for triticale compared to other feed grains makes triticale an attractive proposition, and there is a high demand for it in livestock-rearing regions, especially in the dairy and pig industries. [14]

11 E Downey (2015) Dairies find value in triticale. 18 March. The Australian Dairyfarmer, http://adf.farmonline.com.au/news/magazine/feed/cropping/dairies-find-value-in-triticale/2726590.aspx

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

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

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

Table 1: *Dry matter, energy, protein and fibre content (dry matter basis) of cereals and pulses commonly fed to sheep. The average across the range of values tested in WA is shown in brackets.*

Cereals and pulses	Dry matter (%)	Metabolisable energy (MJ/kg)	Crude protein (%)	Acid detergent fibre (%)
Wheat	91	12.4–13.3 (12.9)	7.5–15.0 (11.5)	2.5–4.5 (3.0)
Barley	91	11.6–12.2 (11.9)	7.0–13.0 (11.0)	7.0–9.5 (8.0)
Triticale	90	12.0- 13.0 (12.5)	7.5–14.0 (11.0)	3.5–5.0 (4.0)
Oats	92	10.4–11.3 (10.7)	5.5–13.5 (9.0)	16.0–21.5 (18.5)
Narrow leaf lupins	92	13.1–14.1 (13.7)	27.0- 42.0 (34.0)	17.5- 23.0 (20.0)
Albus lupins	92	13.4- 15.0 (14.0)	34.0- 44.0 (38.0)	17.0- 21.0 (19.0)
Peas	91	12.5–13.5 (13.0)	21.5–30.0 (25.5)	6.0–10.5 (9.0)
Vetch	91	12.4–13.2 (12.8)	26.0–34.5 (29.0)	7.5–9.5 (8.5)
Chick peas	91	12.0–13.0 (12.4)	18.0–24.0 (21.0)	12.0–16.0 (14.0)
Faba beans	90	12.4–13.2 (12.9)	22.0–30.0 (26.0)	7.5–9.5 (8.5)
Canola (>35% oil)	95	15.0–17.0 (16.0)	20.0–25.0 (22.0)	22.5–26.5 (24.0)

Source: DAFWA

MORE INFORMATION

Triticale: stock feed guide

A guide to the use of triticale in livestock feeds

Triticale offer benefits over wheat for biofuel

A.1.3 Triticale for biofuel

Triticale also has a use in alternative fuels, which are increasingly sought after owing to the impending shortage of fossil fuels, and increasing global concern about the health of the environment. Biofuels are produced from organic matter and are a possible alternative fuel. Modern cultivars of triticale make a competitive feedstock for ethanol production. This is because it possesses an auto-amylolytic enzyme system that aids in converting large quantities of starch into fermentable sugars. It is better suited to the production of biofuel than wheat. The use of triticale for biofuels has been explored in Europe, and may have potential elsewhere in the world.

A.2 Growing regions

The Northern region includes all of Queensland and stretches as far south as the NSW-Victoria border.

This region consists of varying weather patterns, from summer dominant in the north to a more temperate, winter based rainfall system in the southern parts of NSW.

With the wide climatic variations in the Northern region, sowing and harvesting times can vary greatly from north to south. Sowing time depends on what crop is being grown, location and use pattern for this crop. For example, forage crops such as

triticale and oats will be sown from early march in the south of the region but the bulk of the bread wheats would not be sown till May. Whilst in central Queensland the main season or bread wheats would be sown as early as March. Consequently, the harvest of the northern region's winter crops can stretch from September through to December.

Similarly, in the Northern region, summer crops are planted from September to February, with harvest spanning the period February to May.

The main grain crops grown in the northern region are:

- Winter—wheat, barley, oats, chickpeas, triticale, faba beans, lupins, field peas, canola, vetch, safflower and linseed (Figure 1).
- Summer—sorghum, sunflowers, maize, mungbeans, soybeans, cotton and peanuts. [15]

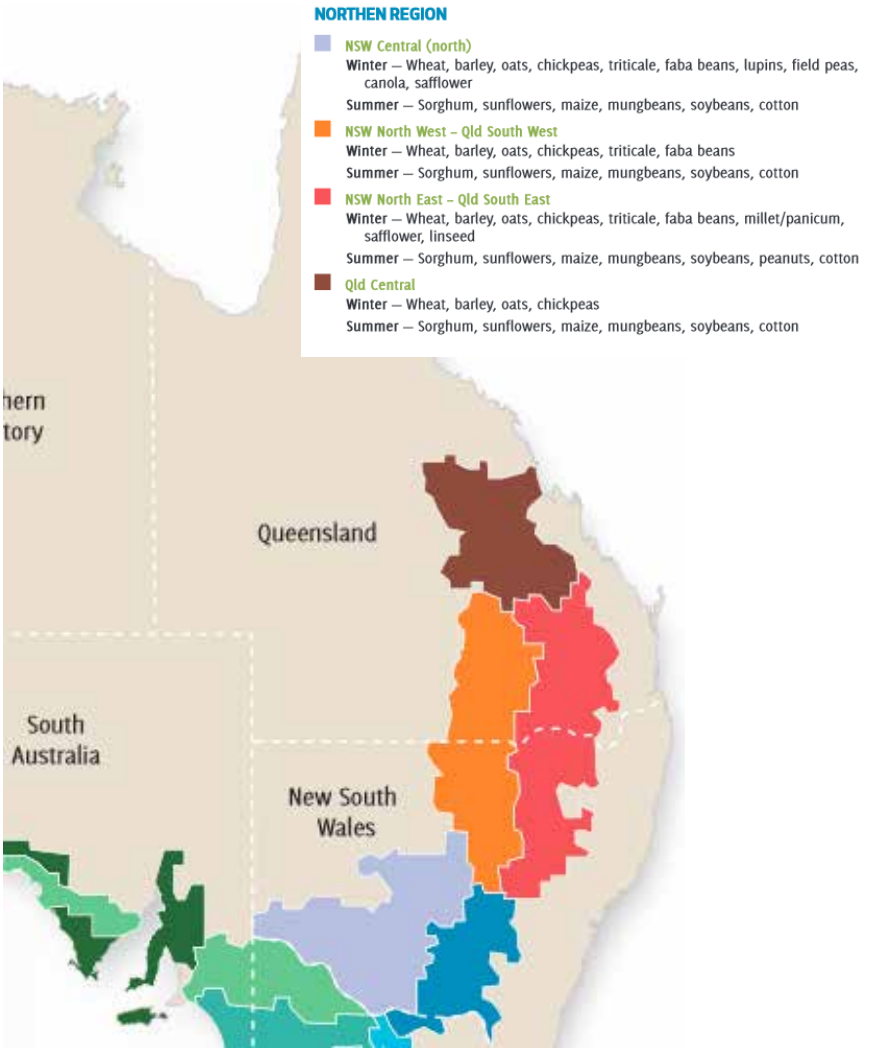

Figure 1: *Agro-ecological zones and corresponding crops grown in the northern region.*

Source: AEGIC

15 Australian Export Grains Innovation Centre (2016) Australian grain production: a snapshot. AEGIC, http://aegic.org.au/australian-grain-production-a-snapshot/

A.3 History of triticale growing

The first wheat–rye cross-breeding occurred in Scotland in 1875, but the grain was sterile; in 1888, German botanists discovered how to produce a fertile hybrid of the two grains. The name triticale first seems to have been used in Germany about 1935. [16]

In the 1950s, plant geneticists hoped that a cross-fertilisation of wheat and rye would produce a cereal with superior yield. They developed a grain with the hardiness and disease resistance of rye that combined with the milling and baking qualities of wheat.

In 1970, the first commercial variety of triticale went on sale and triticale bread, flour and breakfast cereal became available. During this time, triticale was touted as a miracle crop, but initial interest faded when crops proved to give inconsistent yields, and after that acceptance was slow. Even now, triticale breeders have not achieved their objective to see triticale dominate as a grain for food production, although it is found in a range of grain foods in Australia. [17]

A.3.1 Triticale in Australia

Triticale varieties were introduced into Australia in the early 1970s as experimental lines for evaluation. Breeding and selection programs were initiated by several universities and state departments of agriculture, and a number of varieties were released, mostly spring-grain lines introduced from the International Maize and Wheat Improvement Center (CIMMYT). Triticale was quickly taken up as a useful crop for grain and fodder production on acid and waterlogged soils, and for producing an economical and soil-conserving crop on lower-rainfall, nutrient-impoverished soils. Initially, triticale was mostly used on the farm or traded locally as stockfeed. On the one hand, it was often sought as a more easily traded feed grain than wheat, which had to be marketed through the Australian Wheat Board. On the other hand, since it was not well-known, and as the quantity available was limited, in some areas triticale could prove difficult to sell for a good price, and this tended to limit its adoption.

The first Australian cultivar was Growquick, a later-maturing line of poor grain type most suitable for grazing. By the mid-1980s, 11 grain cultivars had been released.

In the early 1980s, wheat stem rust races evolved in Queensland that were virulent on these cultivars. In order to reduce the likelihood of rust epidemics and further evolution of virulent races, agronomist and seed sellers stopped recommending rust-susceptible cultivars, and breeders sought to produce cultivars with full rust resistance. Once this was achieved, an increasing amount of triticale was produced, and after many years of good results, users gained confidence in the grain, driving an increasing demand for triticale and improved prices.

By the early 2000s, triticale had gained popularity in Australia, mainly in southern regions, to the point where it was treated as an economic crop. More recently, the area of production has declined. [18]

Figure 2 shows the decreasing volume and low area planted to triticale over the last 20 years. This decline is likely due to the crop being disadvantaged in relative yield against wheat and barley.

16 Whole Grains Council. Rye + triticale August grains of the month. Whole Grains Council, http://wholegrainscouncil.org/whole-grains-101/easy-ways-enjoy-whole-grains/grain-month-calendar/rye-triticale-august-grains-month

17 Grains and Legumes Nutrition Council (2016) Triticale. Grains and Legumes Nutrition Council, http://www.glnc.org.au/grains/types-of-grains/triticale/

18 KV Cooper, RS Jessop, NL Darvey. In M Mergoum, H Gómez-Macpherson (2004) Triticale improvement and production. FAO Plant Production and Protection Paper No. 179. Food and Agriculture Organisation, http://www.fao.org/docrep/009/y5553e/y5553e00.htm

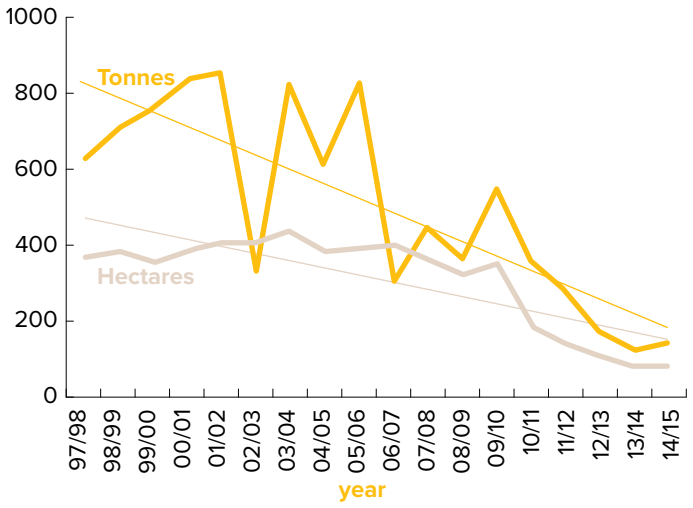

Figure 2: *Triticale Production 1997/98–2016/17 ('000 tonnes and hectares).*

Source: ABS Agricultural Commodities and ABARES Crop Reports.