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TRITICALE

SECTION A

INTRODUCTION

CROP OVERVIEW | GROWING REGION | BRIEF HISTORY

Introduction

A.1 Crop overview

Triticale is an established small cereal crop which combines the productivity of wheat with the hardiness of rye. Triticale was developed by human intervention from crosses between 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 colour 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 rusts. It is as high a quality feed grain as wheat and is a hardy plant.

It makes good use of land that is marginal for other cereals. 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 two levels of manganese and copper. Triticale is well established as an ingredient in livestock rations.

Photo 1: *Wheat (left), rye (middle) and triticale (right) grain. 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. Triticale can out-yield barley under good conditions, and 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 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.

Triticale and wheat are similar crops, but triticale represents a valuable alternative to wheat due to its greater biomass production and grain yield in Mediterranean-type growing conditions, such as those in parts of southern Australia. [1]

Triticale can be less susceptible to the common fungal diseases of cereals which make it suitable for use in rotations where stubble is retained. Some varieties have

1 Bassu, S., Asseng, S., Giunta, F., & Motzo, R. (2013). Optimizing triticale sowing densities across the Mediterranean Basin. *Field Crops Research*, *144*, 167–178.

good resistance to stem, leaf and stripe rusts, mildew and Septoria tritici blotch as well as both resistance and tolerance to Cereal Cyst Nematode (CCN).

Triticale has poor tillering capacity and good tolerance to shattering. This makes triticale a useful cereal as a cover crop to establish undersown lucerne or medic, but seeding rates may need to be reduced. [2]

Besides its use as a feed grain, triticale can be used as a forage crop for ruminants and as a cover crop.

When added to a rotation, triticale may increase yields of other crops in the rotation, reduce costs, improve distribution of labour and equipment use, provide better cash flow, and reduce weather risk. Additionally, production of triticale may provide environmental benefits, such as erosion control and improved nutrient cycling. [3]

Triticale yields more than its ancestors in two types of marginal conditions; highlands where acid soils, phosphorus deficiency and foliar diseases are dominant, and in the arid and semi-arid zones where drought affects crops production. [4]

Observed traits suggested for the higher yields in triticale than wheat include greater early vigour, a longer spike formation phase with same duration to flowering, reduced tillering, increased remobilization of carbohydrates to the grain, early vigorous root growth and higher transpiration use efficiency. [5]

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. [6]

Triticale usually commands a lower price per tonne at the farm gate. An exception to this can be where there is strong local demand for feed grain, where a better cash return with low transport costs could be expected. [7]

The market for triticale is small compared to other cereals as it must compete with barley as the preferred winter feed grain. To combat this, breeders have released improved and better adapted varieties that have good yield and grain quality characteristics, with many of the factors identified as the cause of inferior performance having been eliminated. [8]

MORE INFORMATION

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

Triticale agronomy

A.1.1 Triticale for human consumption

Small amounts of triticale are marketed as niche products for human food consumption. Uses include as a flour supplement to wheaten flour for bread, biscuits and cakes, as rolled whole grains for breakfast cereals, triticale noodles and in the brewing and distilling industries (Photo 2). Triticale has a distinctive nutty, aromatic and naturally sweet flavour. [9] 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 to triticale may take some time to promote.

2 Agriculture Victoria. (2012). Growing Triticale. http://agriculture.vic.gov.au/agriculture/grains-and-other-crops/crop-production/growing-triticale

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

4 Mergoum, M., & Macpherson, H. G. (2004). *Triticale improvement and production* (No. 179). Food & Agriculture Org..

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

6 Cooper KV, Jessop RS, Darvey NL – Triticale in Australia – in Mergoum, M., & Macpherson, H. G. (2004). *Triticale improvement and production* (No. 179). Food & Agriculture Org. http://www.fao.org/docrep/009/y5553e/y5553e00.htm

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

8 Online farm trials. (2004). Triticale agronomy. http://www.farmtrials.com.au/trial/13801

9 Agriculture Victoria. (2012). Growing Triticale. 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 range of cereal grains in their diets. This increased consumption of grains, together with the current consumer trend of trying new and novel products, is leading to an increase in consumer interest in seeking baked products, such as breads baked using cereal grains other than wheat. Thus, given the nutritional and agronomic advantages of triticale, the improvements taking place in terms of baking potential, as well as increasing level of consumer interest in products made from alternative grain cereals, triticale is believed to have the necessary attributes to become an important food cereal for humans in future. [10]

Main culinary uses of triticale:

- Triticale 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.
- Triticale flakes – whole grain triticale is pressed and rolled, which than may be used like rolled oats to make a hot breakfast cereal or substituted for rolled oats in recipes (e.g. in cookies and muffins).

Nutrition credentials of whole grain triticale:

- Similar to wheat, with 13% protein, but lower in lysine and niacin.
- Lower in protein complex which forms gluten.
- A good source of phosphorus and magnesium and a very good source of manganese.
- Contains B-group vitamins, most notably thiamin and folate. [11]
- One study suggested that triticale could be a food source that reduced obesity and diabetes problems. [12]

MORE INFORMATION

Food uses of Triticale

A.1.2 Triticale for animal consumption

Triticale 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

10 McGoverin, C. M., Snyders, F., Muller, N., Botes, W., Fox, G., & Manley, M. (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.

11 Grain and legumes nutrition council. (2016). Triticale. http://www.glnc.org.au/grains/types-of-grains/triticale/

12 Cooper 1985 – in Tshewang S. (2011). Frost tolerance in Triticale and other winter cereals at flowering. https://e-publications.une.edu.au/vital/access/manager/Repository/une:8821;jsessionid=C91FFA8964B3A49AD3A44FC3BD03EA2E?exact=sm_contributor%3A%22Birchall+C%22

an advantage over barley due to its high metaboliseable energy, palatability and ease of milling. [13]

The major uses for triticale grain are as a feed supplement in the dairy industry, as a component ingredient in beef feedlots and as a constituent of compound rations for intensive livestock (pigs and poultry) rations. In livestock diets, triticale has a similar role to other cereals. Triticale is higher in energy than barley and has many desirable nutritional characteristics for all classes of livestock. It is primarily an energy source having moderate protein content with high starch and other carbohydrates, giving it high energy content.

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

Source: The Australian Dairy Farmer

Triticale 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 (essential amino acid content and availability). In dairy rations triticale has an advantage over barley due to its high metabolisable energy, palatability and ease of milling. [14]

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 inclusion in livestock diets.

On farm, triticale can be fed to livestock in the same way wheat or barley would be fed. [15]

Triticale growing regions correspond with the bulk of Australia's intensive livestock production, making triticale grain readily accessible by most feed mills.

There is a high demand for feed grain in the Wimmera region, 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. [16]

MORE INFORMATION

Triticale: stock feed guide

A guide to the use of Triticale in livestock feeds

13 Online farm trials. (2004). Triticale agronomy. http://www.farmtrials.com.au/trial/13801

14 Birchip Cropping Group. (2004). Triticale agronomy – 2004. http://www.farmtrials.com.au/trial/13801

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

16 University of Sydney. (2012). Triticale.

MORE INFORMATION

Triticale offer benefits over wheat for biofuel

A.1.3 Triticale for biofuel

Alternative fuels are required owing to the impending shortage and soaring prices of fossil fuels, and increasing global concern about the welfare of the environment. Biofuels are produced from organic matter and are a possible alternative fuel. Modern cultivars of triticale are a competitive feedstock for ethanol production. Advantageously, triticale possesses an autoamylolytic enzyme system that aids in converting large quantities of starch into fermentable sugars. Triticale is better suited to the production of biofuel than wheat. The use of triticale for biofuels has been explored in Europe and could have potential elsewhere in the world.

A.2 Growing region

Australia's Western growing region comprises the cropping areas of Western Australia (WA), where soil fertility is generally low to very low, and yields depend on winter and spring rainfall.

In many areas, yields are low compared to global standards; this is compensated for by the large scale and degree of mechanisation of cropping enterprises. Due to long-term variability in seasonal rainfall, production is lower in the coastal areas of WA than in the Northern and Southern regions of WA.

Wheat, barley, canola and lupins are the dominant crops, with livestock enterprises in mixed farming systems often of less importance than in other regions of Australia. The Western Region has a relatively small population and feed industry, so the state is export-oriented, with 80–90% of annual grain production exported to more than 50 countries worldwide with Asia and the Middle East our largest markets.

The grains industry is the largest agricultural sector in Western Australia delivering around $4.2 billion to the state economy each year – with the majority of this coming from cereal production ($3.3 billion) and contributions from oilseeds ($0.7 billion) and legumes ($0.15 billion).

WA produces about 10 million tonnes of grain each year from around 4000 rain-fed farms ranging in size from 1000 to 15 000 hectares.

The state's grain production area, known as the 'wheatbelt', covers seven million hectares across the south-west corner of the state. [17]

The climate in south-western Australia is Mediterranean, with hot dry summers and agriculture relying heavily on winter rain. Dryland cereal cropping, mixed with sheep and beef farming is predominant in the northern, central, great southern and south eastern agricultural regions. Higher winter rainfall and sufficient ground water supplies in the South-West region allows irrigation of pastures for dairy and beef, fruit, and vineyards for both table and wine grapes. Forestry has also been a major industry in the past. [18]

A.3 Brief history

The first wheat/rye cross-breeding occurred in Scotland in 1875, but this crossing was sterile; in 1888, German botanists first discovered how to produce a fertile hybrid of the two grains. The name triticale first seems to have been used in Germany about 1935. [19]

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

17 DAFWA. (2016). Western Australian Grains Industry. https://www.agric.wa.gov.au/grains-research-development/western-australian-grains-industry

18 Soilquality.org (2016). Western Australia. http://www.soilquality.org.au/au/wa

19 Whole grains council. Rye + Triticale August grains of the month. http://wholegrainscouncil.org/whole-grains-101/easy-ways-enjoy-whole-grains/grain-month-calendar/rye-triticale-august-grains-month

In 1970, the first commercial variety of triticale went on sale and triticale bread, flour and breakfast cereals became available. Triticale was hyped as a miracle crop during this time, but initial interest faded when crops were inconsistent and acceptance was slow. As such, triticale has not achieved its objectives to dominate as a grain for food production. Today in Australia triticale is found in a range of grain foods. [20]

A.3.1 Triticale in Australia

Triticale was introduced into Australia in the early 1970s as experimental lines for evaluation. Breeding and selection programs were initiated at several universities and state government departments of agriculture, and a number of varieties were released, which were mostly spring-grain lines introduced from CIMMYT. Triticale was quickly taken up as a useful crop for grain and fodder production on acid and waterlogged soils and for producing an economic and soil-conserving crop on lower rainfall, nutrient-impoverished soils. Initially, triticale was mostly used on-farm or traded locally as stock feed. 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, as triticale was not a well-known grain, and as the quantity available was limited, in some areas triticale could prove difficult to sell for a good price, which tended to limit its adoption.

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

In the early 1980s, wheat stem rust races evolved in Queensland, which were virulent on these cultivars. In order to reduce the likelihood of rust epidemics and further evolution of virulent races, the rust-susceptible cultivars were no longer recommended, 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 this grain, driving an increasing demand for triticale and improved prices (Figure 4 and Table 1). [21]

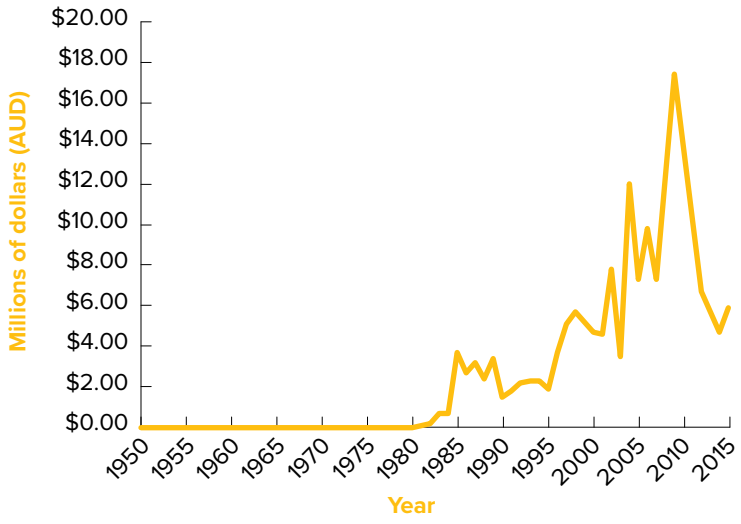

Figure 1: *Gross Value production of Triticale in Western Australia.*

Source: AgData

20 Grain and legumes nutrition council. (2016). Triticale. http://www.glnc.org.au/grains/types-of-grains/triticale/

21 Cooper KV, Jessop RS, Darvey NL in Mergoum, M., & Macpherson, H. G. (2004). *Triticale improvement and production* (No. 179). Food & Agriculture Org. http://www.fao.org/docrep/009/y5553e/y5553e00.htm

Table 1: *Triticale production in Australia ('000 tonnes).*

Year	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960	1961	1962	1963
Production	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Year	**1964**	**1965**	**1966**	**1967**	**1968**	**1969**	**1970**	**1971**	**1972**	**1973**	**1974**	**1975**	**1976**	**1977**
Production	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Year	**1978**	**1979**	**1980**	**1981**	**1982**	**1983**	**1984**	**1985**	**1986**	**1987**	**1988**	**1989**	**1990**	**1991**
Production	0	0	0	0	0	6	13	36	21	28	23	25	11	15
Year	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
Production	17	18	22	12	20	35	35	43	35	30	40	23	73	47
Year	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**				
Production	60	36	na*	70	na*	19	36	12	17	22				

Source: Australia Bureau of Statistics. * Data not collected for 2008 and 2010