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GRDC GROWNOTES™

GRDC
GRAINS RESEARCH & DEVELOPMENT CORPORATION

CEREAL RYE

SECTION A

INTRODUCTION

CROP OVERVIEW | GROWING REGIONS | BRIEF HISTORY

Introduction

A.1 Crop overview

Cereal rye (*Secale cereale,* Photo 1) is a versatile crop, closely related to wheat and barley but a hardier variety. It is a comparatively modern cereal, first cultivated in northern Europe. Rye is thought to have originated from wild types of rye, which are weeds in wheat crops in Asia Minor. Rye is grown for grain, forage, green manure or as a cover crop for erosion and compaction control. Rye is the most productive of the cereal grain crops under conditions of low temperature, low fertility and drought.

Photo 1: *Cereal rye grain heads.*

Source: Plant Village

For more information on cereal rye as a cover crop, see Cover crops.

A.1.1 Comparative notes

- Rye is more cold- and drought-tolerant than wheat.
- Oats and barley do better than rye in hot weather.
- Rye is taller than wheat and tillers less. It can produce more dry matter than wheat and some other cereals on poor soil under drought conditions but is harder to burn down than wheat or triticale.
- Rye is a better soil renovator than oats, but brassicas and Sudan grass (*Sorghum x drummondii*) provide deeper soil penetration.
- Rye generally contains less nitrogen than brassicas, which scavenge nitrogen nearly as well as rye and are less likely to tie it up because they decompose more rapidly. [1]

A.1.2 Description

Rye has an erect slender stem topped with a curved spike 7–15 cm long (Photo 2). The head is made up of individual spikelets, each with two florets producing one or two kernels (Table 1). The spikelets are arranged alternately along the length of the head. The leaves of the plant grow from nodes on the stem and are lance-like blades,

1 A Clark (Ed.) (2007) Managing cover crops profitably, 3rd edn. Sustainable Agriculture Network, Beltsville, MD, http://mccc.msu.edu/wp-content/uploads/2016/08/ManagingCCProfitably.pdf

blue-green in colour. Rye can reach one to three metres in height, and it is grown as an annual (spring rye) or biennial (winter rye). [2]

Photo 2: *The rye seed head (left) is slender, and longer and somewhat nodding compared to the wheat seed head (right).*

Source: University of Nebraska

Table 1: *Characteristics that differentiate wheat from rye.*

Characteristic	Wheat	Rye
Stems	Erect and freely branching at base, 60–100 cm tall	Larger and longer than wheat
Leaves	Blade 1–2 cm wide, usually dark green in color	Coarser and more bluish than wheat
Ligules	Membranous with an irregular edge fringed with minute hairs	Membranous, short and somewhat rounded
Auricles	Purple changing to white, sharply curved and always present	White, narrow and withers early
Seed head	5–13 cm long, oblong or elliptical in shape	Slender, longer than wheat, and somewhat nodding
Seed	Roughly egg-shaped and light brown to darker red	Narrower than wheat and usually brownish-olive to yellow in colour

Source: NebGuide

Rye grain is smaller and darker than wheat, is harder to mill and produces a lower percentage of flour. Rye can be milled into flour or used whole or cracked in many recipes. Whole-grain rye flour includes the bran, germ and the endosperm and is slightly coarser and darker than the finer grades of flour. The protein concentration of rye is less than that of wheat. Rye flour does not have true gluten proteins but it does contain proteins that make a nutritious, dark, heavy leavened bread. Rye flour also has a higher content of soluble fibre. [3]

Hectolitre (hL) weight is normally about 70–75 kg, with a minimum of 70 kg/hL and maximum moisture of 12% for marketing purposes. Grain protein tends to be slightly lower than that of wheat. The dough lacks the elastic properties of wheaten dough. Bread made from rye flour has a close texture and a slight 'tang'.

Rye is a winter–spring cereal, with a growing period similar to the main winter–spring cereals such as wheat, oats and barley. Rye is sown in May–June for grain, and March–April for grazing. Harvesting is in October–December, depending on the region. Rye withstands adverse conditions better than other cereals. It can withstand cold and limited waterlogging. More importantly, its drought-tolerance and ability to withstand sand blast enables it to produce a soil-binding cover on land where other

2 Plant Village (2015) Rye: *Secale cereale*. Penn State University and École polytechnique fédérale de Lausanne, https://www.plantvillage.org/en/topics/rye/diseases_and_pests_description_uses_propagation

3 B Van Veldhuizen (2010) Growing small grains in your garden. Agricultural and Forestry Experiment Station Circular 135. University of Alaska Fairbanks, February 2010, http://www.uaf.edu/files/snras/C135.pdf

cereals will not grow. Under conditions where wheat, oats or barley will grow only a few centimetres high, or they may even be completely blown away, rye often will grow vigorously and reach a height of a metre or more.

Demand for cereal rye has been static for a number of years, with domestic consumption ~25,000 tonne per annum. Local use for rye is mainly in the form of kibbled rye or cracked grain for use in mixed-grain breads or for breads requiring more fibre. Demand has also increased, but to a lesser extent, for sourdough rye bread, rye flour and rye meal.

Production in Australia is generally erratic, with supply and demand very elastic and price-sensitive. Seasonal conditions, and the soil type and topography where rye is usually grown, greatly influence seasonal production. [4]

Grain is generally traded directly to merchants with prices fluctuating according to supply and demand. Some merchants may offer sowing contracts, usually with a guaranteed price based on a fixed area and estimated yield. Growers should confirm receival standards before entering into any contracts (see GTA Trading Standards). [5]

Cereal rye should not be confused with the aggressive weed annual ryegrass (*Lolium rigidum*). For more information, see Annual ryegrass or cereal rye?

A.1.3 Rye for human consumption

Cereal rye can be grown as a grain crop for alcoholic beverages and food. Cereal rye is quite distinct from wheat for bread making; the dough lacks elasticity and gas-retention properties. Used alone, it produces a distinctive black bread. Lighter rye loaves are produced from rye and wheat mixtures. Rye flour, rye meal and kibbled rye are all end-products (Photo 3). Rye flour and meal are used in rye bread and biscuits. Plump grain is highly sought after for kibbled rye manufacture. [6]

Photo 3: *Wholegrain rye flour (left) and kibbled rye (right) milled for human consumption.*

Source: Blue Lake Milling

4 Agriculture Victoria (2013) Growing cereal rye. AgNote no. 0403. Agriculture Victoria, May 2013, http://agriculture.vic.gov.au/agriculture/grains-and-other-crops/crop-production/growing-cereal-rye

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

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

A.1.4 Rye for animal consumption

Cereal rye can be grazed. When used as grazed forage, cereal rye is usually mixed with other cool-season species such as triticale. Rye can be cut for hay at the early heading stage of development. [7] Cereal rye should be mixed with other grains when fed to monogastrics, especially chickens. It has a high content of soluble pentosans (a class of polysaccharide, a type of carbohydrate molecule), which can cause decreased weight gain and sticky droppings in chickens. [8]

Grain

Rye grain has a feeding value about 85–90% that of maize, and contains more digestible protein and total digestible nutrients than oat or barley. Rye is most satisfactorily used when mixed with other grains at a proportion less than one-third, because it is not highly palatable and is sticky when chewed. [9]

One study compared the effectiveness of rye grain and wheat grain for feeding sheep. There was no significant difference in liveweight change between sheep fed rye and sheep fed wheat. Sheep with free access to grain (production group) ate more rye than wheat. The reason is not known, but rye did not depress feed intake compared with wheat. Sheep offered maintenance rations ate all of the grain on the day it was fed. The results indicate that rye and wheat perform equally as maintenance and production rations for sheep. However, farmers should observe their sheep closely when first using rye grain. [10]

Forage

Rye makes excellent forage, especially when combined with red or crimson clover (*Trifolium pratense, T incarnatum*) and ryegrass (*Lolium* spp.). For best quality, rye should be cut between early heading and the milk stage of growth. Rye matures earlier and has higher crude protein levels than wheat and triticale. However, rye forage yields are lower, resulting in somewhat lower crude protein yields and overall lower relative feed values. Thus, the main advantages of winter rye as a forage compared with winter wheat or winter triticale is that it is more winter-hardy and reaches optimum harvest maturity 7–10 days earlier.

Pasture

In the growth stage before heading, rye is used extensively as a pasture crop. Rye generally provides more forage than other cereals in late autumn and early spring because of its rapid growth and its adaptation to low temperatures. Although rye is a less palatable pasture crop, it is readily grazed when other green forages are not available. [11]

A.2 Growing regions

The Northern region takes in central and southern Queensland, and New South Wales (NSW).

Most rainfall in the north of the region tends to be over summer, allowing for dryland summer crop production. However, with the high moisture-storing capacity of the clay-based soils of these zones, supplemented by some winter rainfall, winter crops are also successfully produced. Winter crops in the north of the region are planted across a wide period, starting in March in central Queensland, through to July in central NSW. Consequently, harvest can stretch from September through to

7 PA Casey (2012) Plant guide for cereal rye (*Secale cereale*). USDA Natural Resources Conservation Service, May 2012, https://plants.usda.gov/plantguide/pdf/pg_sece.pdf

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

9 EA Oelke, ES Oplinger, H Bahri, BR Durgan, DH Putnam, JD Doll, KA Kelling (1990) Rye. In Alternative field crops manual. University of Wisconsin and University of Minnesota, https://hort.purdue.edu/newcrop/afcm/rye.html

10 B Ashton, D Rendell, A King (1992) The value of cereal rye as a grain for feeding sheep. Proceedings of the Australian Society of Animal Production, Vol. 19, http://www.asap.asn.au/livestocklibrary/1992/Ashton92.PDF

11 EA Oelke, ES Oplinger, H Bahri, BR Durgan, DH Putnam, JD Doll, KA Kelling (1990) Rye. In Alternative field crops manual. University of Wisconsin and University of Minnesota, https://hort.purdue.edu/newcrop/afcm/rye.html

December. Similarly, summer crops are planted from September through to February with harvest spanning February–May.

The south of the region is southern New South Wales (south of Dubbo). The rainfall pattern ranges from uniform in central New South Wales through to winter-dominant further south. Dry summers and comparatively reliable winter rainfall lend themselves to winter crop production. Planting of the winter crop depends on 'opening rains' and usually begins in May and can continue through until late July. The winter crop harvest can begin in late October and continue through to January. Summer crop production requires irrigation and the major field crop irrigated in this region is medium-grain rice in southern New South Wales. [12]

The main winter cereal crops in NSW are wheat, barley and oats, with lesser areas sown to rye and triticale. [13]

A.3 Brief history

Domesticated rye occurs in small quantities at a number of Neolithic sites in Turkey but is otherwise virtually absent from the archaeological record until the Bronze Age of Central Europe, circa 1800–1500 BCE. It is possible that rye traveled west from Turkey as a minor admixture in wheat, and was only later cultivated in its own right. Since the Middle Ages, rye has been widely cultivated in Central and Eastern Europe and is the main bread cereal in most areas east of the French–German border and north of Hungary. [14]

Around the world, the area of cultivated land dedicated to growing rye has decreased substantially since the 1970s. In 1986, the area harvested was 24 million hectares but this had dropped by 29% to 17 million hectares by 1996. The decrease in cultivated area was largely offset by an increase in yield. Yields during the late 1960s were as low as 11.5 centals (~520 kg) per hectare, but had increased by 57% to 18 centals (~816 kg) per hectare by the 1990s. This significant increase in yield was achieved through improvement of agronomic practices, especially in the use of chemical fertilisers and crop rotation, decline in the use of less fertile land, and development of high-yield cultivars. [15]

Cereal rye has been grown in Australia for more than 150 years. Production in Australia is generally erratic, with supply and demand very elastic and price-sensitive (Figure 1).

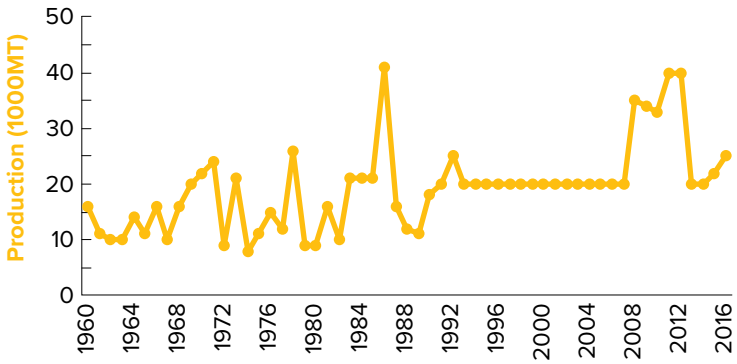

Figure 1: *Australian rye production by year.*

Source: IndexMundi

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

13 JP Brennan, JD Sykes, JF Scott (2004) Trends in pulse and oilseed crops in winter cereal rotations in NSW. Economic Research Report No.26. New South Wales Department of Primary Industries, http://www.dpi.nsw.gov.au/content/research/economics-research/reports/err26

14 D Zohary, M Hopf, E Weiss (2012) Domestication of plants in the old world: the origin and spread of domesticated plants in south-west Asia, Europe, and the Mediterranean basin. Oxford University Press.

15 W Bushuk (2001) Rye production and uses worldwide. *Cereal Foods World* 46, 70–73, http://www.agmrc.org/media/cms/bushuk_C8B79BAB55BB0.pdf