



REFERENCE NOTES

for

NEW CANE GROWERS IN NSW

2022

PREFACE

These notes are not designed to be a comprehensive guide to the growing of sugarcane but are aimed at giving new cane growers an overview of the NSW industry, some issues pertinent to the NSW situation and cane growing practices.

There are numerous publications (Manual of Cane Growing, 2000; Soil-specific Nutrient Management Guidelines for Sugarcane Production in New South Wales, 2013; SRA Weed Management Manual, 2021) that give detailed information about all aspects of cane production some of which has been adapted to the NSW situation.

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NSW SUGAR INDUSTRY – AN OVERVIEW

1.1 Background

The NSW sugar industry is located on three major river systems - the Clarence River (Harwood Mill), Richmond River (Broadwater Mill) and Tweed River (Condong Mill) and a refinery co-located at the Harwood mill. The three mills and refinery are owned by Manildra Harwood Sugars - a joint venture partnership between the NSW Sugar Milling Co-operative and Manildra Stockfeeds. The partnership operates as Sunshine Sugar.

Being the southernmost part of the Australian sugar industry, the industry in NSW has had to adapt to growing cane in a temperate climate which brings some unique challenges. These include severe weather (flood, frost and drought), low temperatures, wet winters, poor drainage and sensitive environmental issues, such as Acid Sulphate Soils. As a result, the industry has developed farming systems based around one and two-year cropping cycles to maximise production.

About 30,000 ha of mostly alluvial soils are used to produce 1.5 to 1.8 million tonnes of cane each year. From this about 200,000 tonnes of raw sugar, valued at around \$100 million, are produced for sale into the Australian market.

1.2 Sustainability

The NSW sugar industry is committed to sustainable cane growing practices that are acceptable to the wider community and is reliant on each grower adhering to best practice guidelines based on sound research.

The industry is proactive about environmental issues, is continually reviewing best practice and aims to ensure that activities of its members do not adversely affect the environment.

In line with this, the NSW Sugar Industry has developed a Farming Code of Practice and has taken the lead in obtaining certification under an internationally accredited sustainability standard – Bonsucro. The certification covers the farms, the mills and the refinery and places us in a unique position to be able to supply sustainably certified sugar products to our many customers.

As the demand for sustainable certification grows, which it is, adherence to best practice management will become more closely scrutinised through the on-farm auditing processes that form part of the certification process.

1.3 Self-Regulation

Cane and sugar production are largely self-regulated to ensure orderly production and marketing. Many of these regulations are covered in the “*Standard Terms and Conditions for the Supply, Processing and Payment of Sugarcane*”. Some of the main regulations are:

- Cane growers must have a **Production Area Entitlement (PAE)**. This is the area on which a grower can grow cane for supply to the mill.
- Only **grow and supply cane** on land that forms part of the Grower’s Production Area Entitlement.
- Cane growers must use their best endeavours to ensure that the Production Area Entitlement is used for planting and growing of cane in a sustainable manner in accordance with recognised

and accepted **Industry Best Practice** principles and the NSW Sugar Industry **Farming Code of Practice**.

- Cane growers must only grow those **varieties** approved by NSW Agricultural Services and abide by any disease regulations proclaimed by NSW Agricultural Services for the mill area in which the Grower's sugarcane is grown.
- Conduct and record any land grading, drain construction, drain maintenance, or other earthworks that may disturb acid sulfate soils, in accordance with the Grower's **Acid Hazard and Drain Management Plan** and the NSW Sugar Industry **Best Practice Guidelines for Acid Sulfate Soils**.
- Ensure that **harvesting arrangements** are in place for cane grown on the Production Area Entitlement.
- Supply to Sunshine Sugar during the season **all of the cane** grown on the Production Area Entitlement, excluding seed cane and cane for standover, of a quality reasonably regarded by Sunshine Sugar as fit for the manufacture of raw sugar of acceptable quality.

1.4 Standard Terms and Conditions for the Supply, Processing and Payment of Sugarcane

Detailed Standard Terms and Conditions for the Supply, Processing and Payment of Sugarcane have been developed for the NSW industry and are intended to ensure the efficient, cost effective growing, harvesting, delivery, processing and payment for the cane supplied by all cane growers to each of Sunshine Sugar's mills.

The terms and conditions deal with such matters as conditions of supply; Production Area Entitlement (PAE); cane price and payment; raw sugar pricing; harvesting and delivery of cane; cane delivery pads, multi-lift roads and access ways; Agricultural Services and frosted cane.

The standard terms and conditions apply for four Crushing Seasons and are automatically extended for a further year at the end of each Crushing Season.

All cane supplied to any Sunshine Sugar mill will be only be accepted on the basis of the standard terms and conditions.

The terms and conditions are negotiated and agreed with NSW Cane Growers Association and reviewed annually.

1.5 Cane Value

The value of sugar cane is determined by its quality and yield. The quality of the cane, called **Commercial Cane Sugar** or **CCS**, is a measure of the percentage of sucrose (sugar) that the sugar mill is deemed able to recover from cane. The CCS and net weight of cane for each delivery (bin of cane) is determined at the mill using agreed and approved methods according to the Cane Analysis System in the Sunshine Sugar Cane Analysis Manual.

Average CCS values for the season typically range between 11 and 12, but values vary considerably through the season. The CCS of cane typically follows a curve starting low at the beginning of the season, peaking in September/ October and falling away in November – December.

So that growers who harvest outside the CCS peak are not disadvantaged, a 'relative' payment scheme applies whereby, each time you harvest cane, the value of cane is calculated based on its CCS relative to the average CCS for the mill for that day. The value of each delivery (bin) of cane is equal to its CCS divided by the average CCS of all cane delivered to the mill for that day, multiplied by the base price for

all cane delivered to the Mill for the season at mill average payment CCS (mill average CCS), multiplied by the net weight of cane.

For example, if each time you harvest, your CCS is 10% above the mill CCS for that day, then your season relative CCS will be 10% above the mill average. If the mill average for the season was 12 CCS, your **relative CCS** would be 13.20 (12.00 x 110/100) and your cane value would be 10% higher than the average.

To put some numbers to this, where the cane price was \$34 per tonne, you would be paid 110/100 x \$34.00 = \$37.40 per tonne of cane.

To maximise cane value, growers should aim to beat the mill average.

1.6 Returns and Costs

Cane Gross Margins

Using average costs of production, the gross margins for 1 and 2-year cane production in NSW are as outlined in the tables below:

Plant Cane

Crop Category	Income (\$/Ha)	Expenses (\$/Ha)	Harvest Cost (\$/Ha)	Gross Margin	
				\$/Ha Harv.	\$/Ha/Year
1-Year-old	\$ 3,738	\$ 1,960	\$ 860	\$ 918	\$ 918
2-Year-old	\$ 5,233	\$ 1,242	\$ 1,204	\$ 1,788	\$ 894

Ratoon Cane

Crop Category	Income (\$/Ha)	Expenses (\$/Ha)	Harvest Cost (\$/Ha)	Gross Margin	
				\$/Ha Harv.	\$/Ha/Year
1-Year-old	\$3,738	\$ 753	\$ 860	\$ 2,125	\$ 2,125
2-Year-old	\$5,607	\$ 1,034	\$ 1,290	\$ 3,283	\$ 1,641

Notes:

1. Yield assumptions are
 - a. 100t/ha for 1 year old and 140t/ha for 2-year-old plant cane.
 - b. 100t/ha for 1 year old and 150t/ha for 2-year-old ratoon cane.
2. Cost of grower labour not included.
3. Planting Costs include a Contract planting cost of \$568/ha.
4. Harvesting at \$8.00/t and levies \$0.60/t.
5. Sugar price \$500/t, CCS 11.9 and cane price \$37.38/t.
6. **The sugar price and input costs can and do vary considerably. These values are as at January 2022.**

For two-year cane, there are often no costs incurred in the second year. However, depending on crop conditions, some growers may apply 60-100 kg N/ha by aerial application or inter-row tractor to cane being grown to 2-year-old (standover cane). Other farm production costs include purchasing clean seed each year, drain maintenance, laser grading and machinery maintenance.

1.7 Cane Payment

Payment for cane is made according to a long-established cane payment formula based on the average daily relative CCS of the tonnes of cane, the tonnes of cane delivered and the weighted average Sugar Price.

The initial price for cane in each season is based on a mill average CCS for the season based on the previous five year's average CCS and an estimated Sugar Price as determined by Sunshine Sugar.

The initial price is used to establish the delivery price (about 50% of the initial price) and an indicative Payment Schedule for that season.

The delivery price is paid through the season for all cane delivered to the mill and is made about two weeks later. Harvesting costs and levies are deducted from this payment. A further payment (about 10%) is made shortly after the end of the crushing season and progressive payments are then made every month thereafter until the final price is determined, which is usually by September of the following year.

An example of a cane payment schedule is shown below:

		2021 Season			
			Condong	Broadwater	Harwood
Delivery ccs			11.9006	12.0840	12.0880
Actual CCS			12.2060	12.6900	12.2150
		Sugar Price	\$ptc	\$ptc	\$ptc
Delivery Payment based on 5-yr Avg		\$ 260	19.44	19.79	19.80
CCS adjustment		\$ 260	\$ 0.59	\$ 1.16	\$ 0.24
Monthly Payment	23-Dec-21	\$ 30	\$ 2.31	\$ 2.42	\$ 2.31
(at start of month)	31-Jan-22	\$ 25	\$ 1.93	\$ 2.01	\$ 1.93
Monthly Payments	28-Feb-22	\$ 25	\$ 1.93	\$ 2.01	\$ 1.93
	31-Mar-22	\$ 25	\$ 1.93	\$ 2.01	\$ 1.93
	30-Apr-22	\$ 25	\$ 1.93	\$ 2.01	\$ 1.93
	31-May-22	\$ 25	\$ 1.93	\$ 2.01	\$ 1.93
	30-Jun-22	\$ 25	\$ 1.93	\$ 2.01	\$ 1.93
Monthly Payments	YTD	\$ 440	\$ 33.89	\$ 35.46	\$ 33.92
	30-Jul-22	\$ 30	\$ 2.31	\$ 2.42	\$ 2.31
	29-Aug-22	\$ 30	\$ 2.31	\$ 2.42	\$ 2.31
	28-Sep-22	\$ 30	\$ 2.31	\$ 2.42	\$ 2.31
Forecast Final Price	Estimate	\$ 530	\$ 40.82	\$ 42.71	\$ 40.86

1.8 The Cropping Cycle

Sugarcane is harvested between June and late November and can be harvested either as one-year-old or two-year-old. After harvest, the cane, being a grass, grows back or “ratoons”.

Condong growers grow a majority of one-year cane and on average harvest around 67% of the farm each year. Broadwater and Harwood growers grow more two-year cane, typically harvesting around 50 - 55% of their farm each year, and around 65 - 70% of the tonnage harvested is two-year cane.

After five to eight years of cane production the old stool is destroyed after harvest and, preferably, left fallow and planted the next year. Most growers grow soybeans or other legume crops between cane cycles. Some growers elect to plough out and replant in the same year.

The main planting months are August -September (Condong) and September-October (Broadwater & Harwood).

Advice on variety selection, crop nutrition and all aspects of sugar cane agronomy is available from local advisory staff. Contact details are listed in Section 1.14. There are numerous manuals, fact sheets and booklets available and you can contact the local advisory staff to obtain these.

1.9 Cane Burning

At present most cane is burnt prior to harvest. The main reason the crop is not cut green is because trash left on the soil after green harvesting can cause ratooning problems in the cool, wet growing conditions common in NSW.

Cane growers have the legal right to burn cane. Burning of cane falls under the provisions of the Rural Fires Act 1997 and the Environmental Planning and Assessment Act 1979.

The Rural Fires Act defines a general Bush Fire Danger Period which normally runs from 1 September to 31 March of the following year and during this period a permit is required for all cane fires. Outside of this period a permit for burning of sugar cane is not required and cane growers can burn cane at any time.

Permits are granted subject to specific conditions which must be adhered to and the person in charge of the fire must ensure that the Fire Danger Rating for the day is checked and that any special conditions that apply are considered when burning cane for harvest or when burning trash and tops post-harvest.

The Canegrower's Association on each river organises burning permits for each farm during the crushing season.

During periods of total fire ban, pre-harvest burns are permitted from 7:00 pm to 7:00 am only.

1.10 Harvesting

Each grower is responsible for making their own harvesting arrangements. This can be either by joining one of the existing grower-owned harvesting cooperatives or by engaging an independent contractor, if one is available.

To make harvesting viable and practical, each harvester needs to harvest at least 50,000 tonnes of cane. To achieve this, a harvester will harvest for many cane growers and a portion of each grower's cane crop is harvested in rotation, 3 -5 times (rounds) during the harvesting season.

Harvesting can be affected by wet weather and different harvesters have different methods for dealing with this and special harvesting arrangements for individual cane growers and price variations can be applied.

1.11 Acid Sulfate Soils and Self-Regulation

About half the NSW cane lands are underlain by acid sulfate soils. When exposed to air, these soils release sulfuric acid which can cause serious water quality and environmental problems. NSW cane growers, by virtue of them holding a PAE and having Acid Hazard and Drain Management Plan, have been granted self-regulation status by the state and local governments to undertake drainage works on their farms. All other land holders must submit a Development Application to their local council before proceeding with any earth works.

Each cane farm in NSW has been soil sampled and issued with an Acid Hazard and Drain Management Plan. This plan specifies what action cane growers must take while undertaking routine earthworks (including drain cleaning) on their farm. The industry has also developed Best Practice Guidelines for Acid Sulfate Soils. All on-farm drain maintenance activities must be in accordance with the Acid Hazard and Drain Management Plan and the Best Practice Guidelines. An audit of randomly selected farms is undertaken each year.

1.12 Other Environmental Issues

Fertiliser and pesticides are potential pollutants. Cane growers should only apply them at recommended rates using best practice application techniques. A water quality monitoring program undertaken by the NSW Sugar industry and industry research bodies showed generally satisfactory levels of nutrients and pesticides in major drainage systems.

The NSW EPA has introduced laws for keeping records of the pesticides used on the farm and these require you to record details of pesticide use within 24 hrs of application and retain these records. It is a legal requirement to keep records. A spray diary is available from agricultural staff at each mill as is a weed and pest control guide. As part of the Bonsucro Accreditation process, a chemical accreditation

certification is a requirement for each grower. Chemical Accreditation courses (initial and refresher) are held regularly, and it is desirable that cane growers participate in these.

1.13 Industry Groups/Organisations

NSW Agricultural Services (Ag Services)

NSW Agricultural Services was formed in 2012 to provide extension and crop protection (pest and disease control) to all cane growers in NSW.

Ag Services is funded by a levy on each tonne of cane supplied to the mill (currently 15 cents) and is paid equally by the farmer and the sugar mill.

The Agricultural Advisory Committee (AAC) with farmer and mill representatives from each river provides recommendations and oversight in relation to services provided to the NSW sugar industry.

Ag Services updated their strategic plan in 2021. The plan supports the Sunshine Sugar Strategic Business Plan which focusses on the whole business from growing, through milling and subsequent refining and delivery to customer.

The focus of the Ag Services plan is to ensure that Sunshine Sugar's mills are supplied with consistent volumes of high-quality cane through a combination of horizontal and vertical expansion initiatives supported by a professional extension and crop protection services to growers.

Sugar Research Australia (SRA)

SRA is the major research and development provider to the Australian sugar industry and is largely funded via a compulsory levy (currently 35c/t of cane) paid by cane growers and mills on every tonne of cane delivered to the mill.

In NSW, the key role of SRA is the variety improvement program and has 3 staff based at Broadwater Mill.

NSW Cane Growers' Association

The NSW Cane Growers' Association represents the interests of its members to all levels of government, the community and Sunshine Sugar. It has branches in each of the three districts. Membership is voluntary and levies are payable.

1.14 Contact Details

Position	Location	Name	Phone
Agricultural Manager	Condong	Malcolm Warren	0408 764 742
Extension Officer	Broadwater	Simon Cristaudo	0434 782 355
Extension Officer	Harwood	Alister Smith	0429 842 472
Cane Protection Field Officer	Condong	Gerard Bambach	0428 662081
Cane Protection Field Officer	Broadwater	Tom Lock	0439 283 404
Cane Protection Field Officer	Harwood	Mark Ensbey	0407 299 182
Cane Supply Manager	Condong	Johan Lambrechts	0413 174231
Cane Supply Manager	Broadwater	Walter Habchi	0499 656 646
Cane Supply Manager	Harwood	Simon Hollis	0413 174236
SRA (Plant Breeding)	Broadwater	Anthony Cattle	0418 694656
Tweed Cane Growers	Condong	Doug Irby	0423 662310
Richmond Cane Growers	Wardell	Florence Dagen	6683 4205
Clarence Cane Growers	Maclean	Brendan Reeves	6645 2515

2. SOME TECHNICAL ASPECTS OF CANE GROWING

2.1 Drainage.

Sugarcane requires well drained soils, with the water table usually kept at least 0.6 metre below the soil surface. As much of the cane land in NSW is low lying and often close to high tide level, considerable efforts have been made to ensure adequate drainage of these lands through comprehensive drainage management systems which include:

- large main drainage canals and tide control structures (floodgates) - much of this installed as part of public flood mitigation works in the 1960s
- open farm drains to feed into these large main drains and natural watercourses
- shallow “vee” or semi-circular “spun” drains within paddocks and along the ends of cane rows to lead water into farm drains
- laser grading of paddocks to ensure that there are no hollows left to allow ponding of water within fields.

Laser grading of fields using large earth moving equipment to accurately grade fields has been widely adopted. This practice offers benefits of increased area available for cropping (no area lost to water furrows), less cost/time lost to slashing of water furrows, no weed ingress from water furrows (no longer present), improved drainage and, in drier periods, more efficient utilisation of limited rainfall.

Growers looking to establish cane on new land that requires drainage, should seek advice from Ag Services.

2.2 Varieties

Sugar cane varieties are initially produced through crossing of parent varieties and the production of true seed. Original seedlings grown from this seed, are subjected by plant breeding research staff to about 10 years of intensive performance testing and selection until commercial varieties are identified and approved for planting.

Sugarcane varieties vary in their yielding ability (vigour), sugar content and maturity pattern (“early” or “late” season varieties), suitability for one- or two-year cropping, harvesting characteristics, ratoonability and resistance and tolerance to frosting, flooding, pests and diseases and herbicides.

In each mill area seven or eight varieties make up the bulk of the crop, and minor or specialised varieties make up the remainder.

New varieties and commercial varieties are distributed to cane growers through the Approved Seed Plot (ASP) system which is managed by Ag Services.

Information on new and old varieties is available from SRA and Ag Services.

2.3 Pests and Diseases

Many, but not all, of the important sugarcane diseases have found their way into Australia, most of them before there was an appreciation of the need for plant quarantine measures. In NSW the main diseases of importance are:

- Ratoon Stunting Disease (RSD): a bacterial stunting disease easily transmitted by contaminated seed and planting and harvesting machinery.
- Orange Rust and Brown Rust disease: leaf fungal diseases
- Pineapple disease: fungus that attacks the newly planted sett
- Sugarcane Smut Disease: a fungal disease
- Chlorotic streak disease (CSD): a soil water borne disease caused by a protozoan spread under wet conditions

- Pachymetra root rot: a fungal disease that occurs mostly at Condong.

The main pests of sugarcane are vertebrate pests (rats, foxes, birds) that destroy standing cane, and insects that attack buds on setts or young shoots (such as wire worms), or prune the root systems of the crop (such as cane grubs).

There are chemicals available to control some of these, for example, fungicides and insecticide are routinely used in planting for Pineapple disease and wireworm/black beetle control, and anticoagulant rat bait materials are used. However, the main control method for many diseases is to grow disease resistant varieties; this applies to rust and smut diseases for example.

Diseases can have a significant yield impact. The photo below shows the effect of Ratoon Stunting Disease (RSD) on cane yield. The RSD free cane on the right yielded around 50% more than the RSD infected cane on the left.



Planting of clean seed plays a big part in controlling pests and diseases and the regular use of clean cane from the local accredited seed plot(ASP) is strongly recommended.

2.4 Soil Specific Nutrient Management

Escalating fertiliser costs, the need to reduce production costs and increasing environmental and community pressure demand responsible nutrient management.

Therefore, on-farm nutrient management should be based on a sound understanding of your soils. To assist growers in NSW improve and utilise their knowledge of different soils on their farms, a reference booklet 'Soil-specific Nutrient Management Guidelines for Sugarcane Production in New South Wales' is available.

The guidelines, also known as the Six Easy Steps, provides growers with the tools to manage fertiliser inputs in a much more precise way and provide a benchmark against which soil and soil analysis can be compared.

The Six Easy Steps form the key elements of an integrated nutrient management system and are:

1. Know which soils occur in each block on your farm.

2. Understand the properties of each soil and the nutrient processes and loss pathways likely to occur in each soil.
3. Test your soils regularly (blocks should be sampled before every crop cycle).
4. Using the guidelines, develop a nutrient management plan for each block.
5. Check the adequacy of applied nutrients (leaf analysis or strip trials).
6. Maintain a good record system.

Implementing the Six Easy Steps will lead to best practice nutrient management and sustainable sugar production.

NSW Ag Services staff can assist with advice on soil sampling, results interpretation and the development of fertiliser recommendations for your farm.

To encourage best practice nutrient management and sustainable sugar production, Sunshine Sugar subsidises half the cost of soil testing.

3. CANE GROWING AND HUSBANDRY

3.1 Planting

Following each harvest, sugarcane can be allowed to regrow (ratoon) a number of times. However, any stool damage incurred during cultivation and harvesting operations or caused by pests and diseases is cumulative and causes successive ratoon-crop yields to decline. Management costs for ratoon cane are much lower than for plant crops, but at some point, it is uneconomic to ratoon the cane and a new crop needs to be planted.

Planting is the most important farm operation as it determines performance of a block for up to seven years. The farmer needs to get a sequence of steps right for a successful plant crop:

- Land preparation
- Time of planting
- Planting material
- Planter operation
- Fertilising
- Subsequent cultivation and weed control

3.1.1 Land preparation

Land preparation (cultivation) for planting removes compaction under the row from the previous crop cycle. It also allows removal of diseased, pest damaged, or otherwise debilitated cane.

The sequence of land preparation cultivations generally includes the following:

- One or two offset discings to remove the old stool; there are variations on this and some growers would plough or use rippers to remove the old stool.
- Possibly one ploughing
- One or two rippings (rip along the old rows and then cross rip at either 90° or 45°)
- A rotary hoeing
- The process of ripping and hoeing could be repeated depending on the conditions and soil.
- In dry periods the hoeings could be immediately followed by a harrow with a roller to retain soil moisture.
- A final rotary hoeing (depending on moisture/rainfall) to provide a fine seed bed. Power harrows have become more widely used as cane growers recognize the fact that overuse of rotary hoes has an adverse impact on soil structure. Because power harrows don't invert the soil like rotary hoes, they assist in moisture retention in dry periods.

There are variations on this for different soil types and where a legume crop is grown in the fallow, or for ploughout and replant where more rapid destruction of the old stool is required. The current trend is to minimise the number of tillage operations to reduce costs and lessen the degradation of soil structure. The aim is to get good tilth for planting at minimal cost.

Some cane growers will 'strip till' the row rather than work the entire field if no laser grading is needed. Double-disc billet planters planting cane following limited or zero tillage (soybean stubble) have produced good results.

3.1.2 Planting time

Selection of planting times is influenced by several factors including climatic conditions, variety, farming system and crop rotation.

Climatic conditions

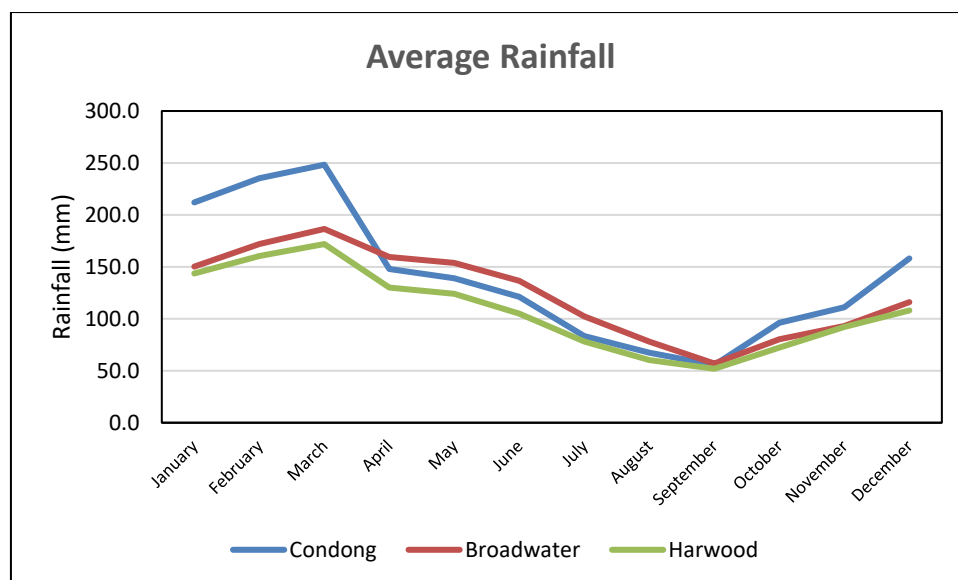
The most important climate variables for planting are soil temperature and moisture.

The major factor affecting germination is soil temperature which must be above 17°C for successful germination. The optimal soil temperature is between 28 and 32°C.

Soil temperature typically reaches a daily average of 18°C in late August at Condong and around the second week in September at Harwood and Broadwater meaning the main planting months are late August - September (Condong) and September - October (Broadwater and Harwood).

Good soil moisture, in addition to soil temperature, is important to achieve good germination. Soil that is too wet or too dry slows germination and may lead to failures.

Long term average rainfall data for each mill area is shown in the chart below.



Rainfall during these months can be highly variable. Don't plant if it's too dry or too wet.

Variety

Varieties differ in their speed of germination and emergence. Slow germinating varieties suffer more from cold wet conditions which can occur following planting. There is plenty of information on cane varieties available from Ag Services staff, from variety productivity reports and SRA (www.sugarresearch.com.au).

Farming System

The improved farming system for sugarcane has been developed over many years through comprehensive research and trials and includes 4 key pillars. These are:

- Reduced tillage
- Controlled traffic
- Legume fallow
- Trash retention

While there is no 'one size fits all' system, the adoption of these key elements delivers significant benefits to the farmer including improved soil health, increased yields, reduced costs and improved operational efficiency.

Research shows that the subsequent yields of sugarcane benefit from a legume fallow. Legume crops have become a critical part of the sugarcane farming system, not just for the soil health benefits they deliver, but also for the additional cash flow they provide the grower.

Each farmer will develop a farming system that best suits their circumstance.

Crop rotation

The average crop cycle in NSW is a plant crop and four ratoons. This means that between 10 and 15% of the farm should be replanted each year. Industry best practice is to include a fallow break and a legume crop between cane crop cycles.

Cane growers wanting to maintain a high rotation percentage, i.e., more of their land under cane and less fallow, have the option of growing more ratoons, ploughout-replanting in Spring or a combination of both. Cane cut in the first harvest round of the season will usually be the blocks that are to be ploughed out and replanted.

Subsequent crops from a plough-out/replant paddock are usually inferior to those from fallow plant cane and short term productivity gains must be weighed against long term soil health benefits.

3.1.3 Planting material

Planting material needs to meet the following criteria for optimum results:

- free from disease and insect damage (from an Approved Seed source)
- erect
- relatively short internodes
- adequate nutritional status
- stress free and actively growing
- sound buds
- most suitable variety

Disease and insect damage

The most common problems encountered are ratoon stunting disease (RSD), chlorotic streak disease (CSD), smut, bud damage from insects and the presence of borer larvae in stalks.

Disease problems are reduced by buying clean seed cane and maintaining farm hygiene to prevent re-infection. Sterilisation of harvesters and other equipment used for cutting planting material is particularly important.

Planting material should be inspected or tested by Ag Services Field Officers for disease (particularly RSD and smut) and insect damage prior to use.

Erectness

While lodged cane can be handled by chopper harvesters for billet planting, it is more prone to eye and sett damage.

Nutritional status

The germinating shoot initially obtains nutrients from the cane sett itself and vigour is reduced if the plant source has a nutrient deficiency. An application of nitrogen fertiliser to planting material 4-6 weeks prior to use can increase early vigour of plant cane.

Sound buds

These are critical for all planting techniques but particularly for billet planting where some damage will occur during harvesting and in the billet planter itself.

Harvesters should be specially prepared for billet planting to minimise damage with sharp base cutter and chopper knives and feed rollers well-worn or rubber coated. Rubber coated rollers in plant cutting harvesters markedly improve the quality of billets for planting. Care with the selection of planting material is required following a frost (particularly in up-river areas) as frost events can cause the buds to die or side shoot.

Varietal suitability

Cane growers should use all available information to select the most suitable variety for their own conditions. This will include their own experience, Ag Services variety and productivity reports, variety performance on neighbouring farms and SRA trial results for new varieties.

3.1.4 Planter operation

Modern planters combine several operations in the one pass: furrow forming, fertiliser application, placement of billets in the furrow, fungicide and pesticide application, closing of furrow and pressing of soil onto the cane sett.

Furrow forming

The optimum planting depth varies with soil type, soil moisture and drainage conditions. Deep planting in sandy soils can lead to excessive cover if the furrow walls subsequently collapse after rain. Similarly, deep planting can cause excessive water logging in poorly drained soils. Many cane growers 'flat plant' in poorly drained soils to minimise germination failures.

Where cane growers have incorporated controlled traffic into their farming system, many are planting into a preformed bed to further reduce waterlogging.

Fertiliser application

Fertiliser applied at planting is referred to as a 'planting mix'. This may be an N & P mixture such as DAP (di-ammonium phosphate) or an NPK mixture. A soil test will indicate the fertiliser required and an application rate.

Planters should be adjusted so that the fertiliser does not come into direct contact with cane setts. This is most critical for sandy soils which are subject to fertiliser burn.

Billet placement

Billets should be placed end to end in the furrow and, in 'wide throat' planters, spread across the furrow without 'criss-cross' stacking. Bunching of setts in the furrow will result in poor soil contact with setts and germination failures.

Fungicide and pesticide application

It is usual to apply a fungicide to cane setts at planting to combat pineapple disease and to apply an insecticide for wireworm and black beetle control. Details of chemicals recommended for use are contained in the Weed and Pest Management Guide available from Ag. Services.

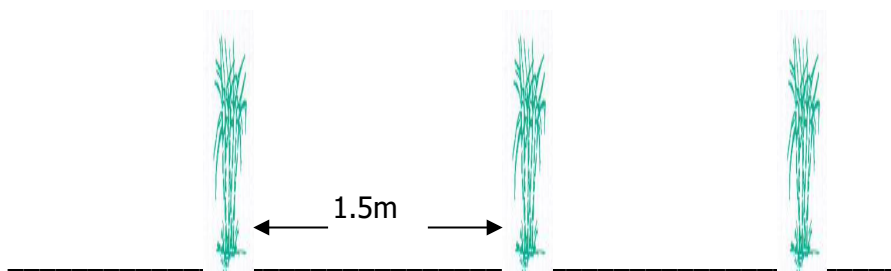
Furrow closure and rolling

The amount of soil cover required over cane setts varies with soil conditions but in general excessive cover or lack of cover reduces germination. Rolling of the furrow after planting to improve contact between the billet and soil is beneficial in some soil types and particularly where tilth is not ideal for planting. Many cane growers aim for 3 to 5 cm of compacted soil cover over the setts.

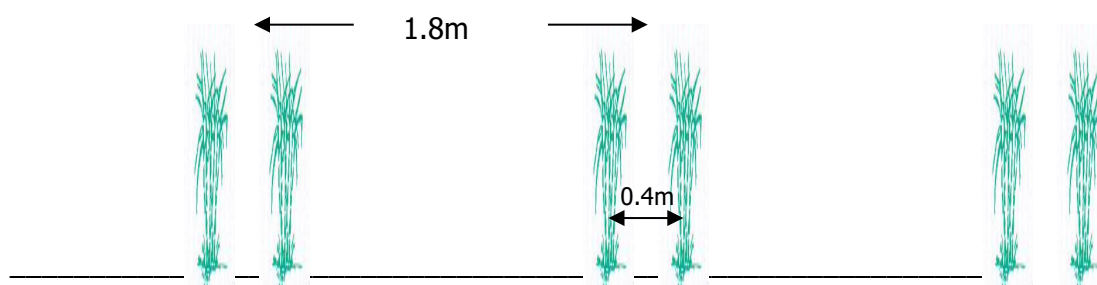
3.1.5 Row spacing

Row spacing has gradually increased over time from the conventional 1.5m in line with the principles of the improved farming system. A range of row spacings exist with 1.65m to 1.8m being most common.

Many growers plant dual rows or wide single rows on 1.8 to 1.9 m spacing to allow for controlled traffic farming which minimises soil compaction, offers substantial benefits for tillage reduction and reduced distance travelled by machinery.



Conventional row spacing - single rows at 1.5m



Dual row spacing - dual rows at 1.8m – matching machinery wheel spacings.

3.1.6 Fertilising

Fertiliser requirements should be based on a soil test.

The planting mix applied with the sett only supplies part of the N,P & K required by the crop. At some time before the cane is at the 'out of hand' stage (unable to work it because of height and/or canopy closure), the balance of the required nutrients is supplied via a side dressing (applied as a band into the soil beside the cane row) in line with the fertiliser recommendation.

3.1.7 Subsequent cultivation

Cultivation of plant cane after planting has the dual purpose of weed control and gradual filling in of the furrow left after planting. Alternatively, herbicides may be used as a tool to control weeds instead of cultivation from planting to the 'fill in' stage (see below).

Following this, the furrow will need to be filled in with the aim of achieving an ideal 'row profile' consisting of a curved hill along the row and a flat interspace. Poor filling in of plant cane is a particular problem for harvesting and it is critical that plant cane is filled in effectively before the 'out of hand' stage. The hill thrown up should be about 90 mm high initially and settle down to about 60mm high by harvest time.

3.2 Ratooning

Since ratoon growth occurs from buds on the cane stool below ground, factors such as soil moisture (too little or too much), stool damage from the harvester and disease and insect damage, determine germination and emergence of ratoon crops. Both the physical condition of the cane stool after harvest and post-harvest management govern the success of the ratoon crop.

Ripping the centre of the interrow to remove compaction and allow improved infiltration and drainage is sometimes practiced but if the subsequent harvest occurs under very wet conditions, then the stool is likely to suffer more damage than where minimum or zero tillage had been practiced.

Alternative ratooning practices in the industry are:

- burnt cane trash blanketing with reduced tillage
- green cane trash blanketing with reduced tillage

3.2.1 Burnt cane trash blanketing

The main purpose of burnt cane trash blanketing is to reduce the cost of ratooning by minimising cultivations. The main operations are for:

- raking of trash from the row into the interrow
- minimal loosening of the soil
- fertiliser application
- weed control

The sequence of ratooning operations includes:

- raking of trash from the immediate area of the stool (research in NSW has shown that retention of trash around the stool especially early in the ratooning season or under wet conditions will inhibit ratooning because of lowered soil temperatures)
- a single pass combining a coulter ripping of the centre of the interspace (benefits are debatable) and fertiliser application.
- control of any weeds using herbicides. Generally, weed growth is reduced under minimum or zero tillage and only minimal spraying is necessary.

3.2.2 Green cane trash blanketing

Green cane trash blanketing offers the combined benefits of minimum or zero tillage and good weed control. The main operations are for:

- Fertiliser application
- Weed control

The sequence of ratooning operations includes:

- A single pass with a fertiliser applicator
- Spraying with herbicide if required

Complete green cane trash blanketing (particularly for early and mid-season harvests) is not possible in the cooler southern areas of NSW because it inhibits ratoon growth.

3.3 Fertilising

Common fertilising practices include annual applications of fertiliser (e.g. Urea or an NPK mix) and less regular use of ameliorants such as lime or gypsum and/or by products such as mill mud and ash.

3.3.1 Fertiliser Requirements

Fertiliser requirements should be based on a soil test as per the Six Easy Steps.

Soil testing is subsidised by Sunshine Sugar and it is a cheap method of determining which fertiliser and application rate is required.

Soil tests are also used to determine the need for ameliorants such as gypsum, lime or dolomite, sulphur or trace elements such as copper and zinc. In poor growth areas soil analysis may indicate the presence of salinity and the need for drainage measures. Sodidity, often a cause of poor soil physical condition and tilth, can also be identified by soil testing.

Leaf testing is also available and is mainly used as a check on the adequacy of fertiliser applications and the need for extra nitrogen in crops being grown as two-year old.

Growers also need to consider other factors such as the sugar price, the cost of fertiliser and the crop class when making decisions around crop nutrition. Contact Ag Services or your local adviser for guidance on this.

Mill mud or mill mud/ash mixtures are available in each mill area and can be ordered through Ag Services. These products supply an almost complete nutrient mixture and are useful for improving soil health (refer to Filter Mud Fact Sheet on the Sunshine Sugar website).

3.3.2 Timing of fertilising

For plant cane, some of the nitrogen phosphorus and potassium for the crop can be applied at planting. The remainder of the nutrients are usually applied via a side dressing or stool splitting before the cane is at the "out-of hand" stage.

In ratoons, either nitrogen alone (as urea) or a mixture of N, P, K is applied post-harvest as a single application using the same methods as in plant cane. Generally, this should be as soon after harvest as possible.

Ameliorants such as gypsum, lime and dolomite are best applied in the fallow to allow mixing in the soil and time for reaction. Mill mud can be applied either in the fallow or to existing crops.

The timing of fertiliser application needs to be carefully considered in relation to the use of pre-emergent herbicides. If a pre-emergent herbicide has been applied, the soil disturbance from the coulters/tine will negate the effect of the herbicide and this can encourage weed growth in the slits.

3.4 Weed control

Weeds compete with sugarcane for water, nutrients and light and there is no doubt that significant reduction in crop yield occurs if weeds are not controlled. Moreover, weeds can make harvesting difficult or impossible and reduce product quality. The combined costs of yield losses due to weeds and herbicide applications make weeds the most important pest of sugarcane production.

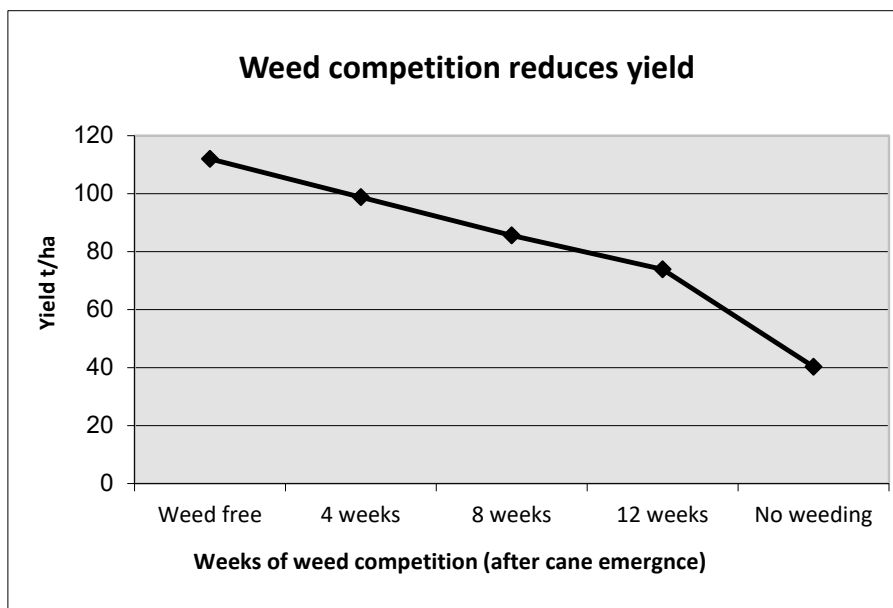


Photo above shows effect of weeds (nutgrass) on cane yield. Cane yield where nutgrass was present (left) was 27% below that of weed free cane on the right.

As with most cane growing areas, the types of weeds in NSW cane lands are grasses, broadleaf weeds, vines and sedges.

Further details on the management of weeds in cane are available in the SRA Weed Management Manual, 2021.

Identification and advice regarding the control methods for the various weeds are available from Ag Services.

3.4.1 Methods of weed control

Mechanical cultivation, application of herbicides and the retention of post-harvest residues are all used to control weeds in cane. Cane growers in NSW currently use a combination of all three methods with herbicide and mechanical cultivation being the most common.

Mechanical

For plant cane crops, many growers opt to use mechanical cultivation to control weeds up to the out-of-hand stage and then apply herbicide. This may be a good option (provided it does not lead to excessive moisture loss from the soil) in very dry weather when lack of soil moisture and rainfall preclude the use of a number of the herbicides. Cultivation of plant cane after planting has the dual purposes of weed control and gradual filling in of the furrow. While the cane drill is still open, cutaway or 'cotton king' and scratcher tines are used for weed control and tillage operations. These implements can effectively cultivate the shoulders and base of the drill, remove weeds and remove excess soil cover. Grubbers or similar tined implements are used to cultivate the interspace and, at the appropriate time, allow soil to be moved into the drill. Once the plant crop furrow is filled in, successive cultivations aim to keep the crop free of weeds and provide an acceptable row profile for harvesting.

Operations in ratoon cane have markedly reduced. Ratooning operations include raking (and perhaps burning) of the tops and trash, cultivation of the interspace using a ripper tine or coulter (to cut the trash) and ripper tine, or grubber tines.

Chemical

Under normal conditions, when there is sufficient soil moisture to activate chemicals, herbicides will usually produce a superior weed control result compared to that achieved by cultivation. The number of herbicides now available, target weeds and management options for the various stages of cane growth is too great to cover in these notes. In addition, new formulations of herbicides are continually being developed to ensure effective, easier and safe weed control.

Numerous factors can affect herbicide performance and failure of a herbicide to adequately control weeds is usually not due to poor product. Poor timing of application is a common source of failure. Spraying actively growing weeds at the correct stage of growth will give the best control, whereas spraying advanced mature weeds with application rates more suited to smaller weeds is a common error. The major imperative in chemical weed control is to treat the weeds when they are very small.

Ag Services produce an annual Weed and Pest Control Guide that provides rates and recommendations for weed and pest control.

3.4.2 Herbicide application

Most cane growers have dedicated spraying equipment consisting of a boom spray (for broadcast spraying) and a set of Irvin legs (for directed spraying under cane plants) or droppers attached to the spray boom. Many herbicides can only be applied as a directed spray and growers need to be aware of the requirement to minimise contact with the cane crop.

Assistance with calibration of spraying equipment is available from Ag Services staff in each mill area.

3.4.3 Environmental issues

There are several challenges facing weed control practices in the cane industry such as offsite impacts, herbicide resistance, consumer acceptance and operator safety.

Most NSW cane lands are drained and there is therefore potential for offsite movement of farm chemicals into waterways.

All users of farm chemicals should attend a chemical accreditation course (initial course and refresher course every 5 years). The NSW EPA has introduced laws for keeping records of the pesticides used on the farm and these require that you record details of pesticide use within 24 hours of application and retain these records. A spray diary is available from Ag Services staff at each mill. There are also many useful apps that can be used.