



Opportunities and Challenges for Developing a Sesame Industry in Australia

Daniel Weinstock¹ & Lewis Hunter²

¹ Australian Sesame Industry Development Associated Limited (ASIDA) & Agri Natura Pty Ltd, ² AgriVentis Technologies Ltd

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Abstract

Australia currently imports all its sesame seeds for domestic consumption, and by 2025 the demand is estimated to reach 9,800 tonnes per annum. Australia has climatic suitability to grow high-quality sesame, however, new varieties and appropriate agronomic practices for mechanised production of sesame in Australia are pre-requisite for economically viable industry development. The Australian Sesame Industry Development Association Limited (ASIDA), a peak body of all sesame stakeholders in Australia, with assistance of AgriFutures, a federal government agency, has strong engagement between stakeholders and a 5 year documented process for effective Research Development and Extension (RD&E) plan implementation to drive sesame production momentum in Australia. Growers and market leaders are focussing on short and medium-term research, development and extension activities to generate practical outcomes for growers, processors and marketers, for the commercialisation of sesame production in Australia.

Keywords: sesame, drought tolerance, bioactive compounds, health food, sesaminol, sesamolin, lignans



Sesame in Global Context

The world's growing population, changing consumption patterns and increasing awareness of health benefits associated with eating sesame seeds has led to recent growth in the sesame market. In 2017 the world production of sesame was approximately 5.5 million tonnes, with the major share being produced in Africa and Asia. In 2018 the global market value of sesame was estimated at US \$6.5 billion. It is expected that by 2025 the global sesame seed market will reach US \$17.8 billion (Rahman et al. 2020). Global sesame production is forecast to reach 9.26 million tonnes by 2040, up from 5.53 million tonnes in 2017. The demand for sesame in China alone is expected to reach 2.56 million tonnes by 2040, up from 1.3 million tonnes in 2016.

According to the FAOSTAT 2020 the leading sesame producing countries of the world are Sudan (0.98 MT), Myanmar (0.77 MT), India (0.75 MT), Nigeria (0.57MT), and Tanzania (0.56 MT). Of the global production over two million tons are exported yearly mainly to China (1 MT), Japan (0.15 MT), Turkey (0.15 MT), European Union (0.15 MT), South Korea (0.1 MT) and Vietnam (0.1 MT). Other major importers are the USA, Saudi Arabia, and the UAE. Natural and hulled sesame seed are the most popular forms for the trading (<https://hlagro.com/blog/sesame-seeds-market-report-2021-beyond/>).

In traditional sesame producing countries the crop is largely produced by small scale farmers using traditional white and black sesame seed, largely dehiscent type, planted and harvested manually. Development of non-dehiscent sesame varieties offers new opportunities for growing sesame as a broad acre crop with mechanised plating and harvesting operation in newer growing areas in the USA and South American countries.



Sesame in Australia

Australian sesame seed is imported from overseas. 6,400 tonnes of sesame seed valued \$12.7 M was imported in 1966 (Bennet, 1995), and the demand gradually increased over time with 6,740 tonnes of sesame seed imported in 2016. The value of imported sesame was \$13.6 M in 2020. The Australian sesame demand for 2025 is predicted to be 9800 tonnes. Strong growth in domestic demand presents opportunities for Australian growers for commercial sesame production in Australia for local consumption and for export.

Feasibility studies for sesame seed production in Australia started during the 1990s in the Northern Territory and Queensland. Australian growers produced 291 tons of sesame seed in 1988-89 but only 90 tonnes in 1993-94. The northern Australian sesame production did not continue as a commercial crop due to the lack of suitable varieties, supply chain coordination, inadequate agronomic support and lack of market coordination.

Introduction of new crop genetics and market players for sesame has established new momentum for sesame production in Australia. About 525 hectares of crop was grown to produce white and black sesame in Australia during 2018. The agronomic challenges for mechanised production, post-harvest processing and market networking are yet to mature to produce a rapid expansion of Australian sesame production.



Sesame Opportunities for Australia

In international markets the average price of sesame seed was US \$1,229/tonne in 2018, with black sesame returning approximately 45% higher than white sesame. The price difference is due to the higher production costs of black sesame, along with high value associated with perceived health benefits. The choice for new varieties (black and white), and opportunities for both domestic and global markets has attracted Australian growers to evaluate sesame as a new crop option for their farm.

The opportunity for expanding Australian production will be determined by a combination of several factors such as growing market demand, climatic suitability, geographic proximity to Asian markets, availability of suitable land, and free trade agreements with major sesame importing countries. Technological innovation, adoption of high-quality sesame varieties, and the economies of scale of Australian production systems will be key to overcoming labour cost competitiveness with overseas suppliers. Together these five factors – growing global demand, proximity to international markets, high crop prices, access to suitable land, and tolerance of Australian environmental stressors – place Australian agriculture in a strong position to establish a viable long-term sesame industry, generating revenue through import replacement and export sales.



Previous Initiatives

In the early 1990s the NT Department of Primary Industry and Fisheries and the QLD Government Department of Primary Industry evaluated number of sesame varieties for adaptation in Northern Australia. Four sesame varieties ('Yori 77' and 'Edith' for NT and northern WA, and 'Aussie Gold' and 'Beech's Choice' for QLD) were marketed through Selected Seed Pty Ltd were recommended for growers in Northern Australia. Preliminary research was also carried out for agronomic adaptation, insect chemistry, diseases and weed control. This early research and extension was focussed on Australian sesame seed production in the NT and Qld, with some application of sesame technologies in NSW. Previous sesame attempts were largely fragmented without a solid RDE plan, weaker variety breeding, inadequate mechanisation options, post-harvest management, and un-linked markets.



Current Situation

Sesame has garnered significant national interest, as seen by the AgriFutures Emerging industry status for sesame. AgriFutures Australia supported developing the Australian Sesame Strategic RD&E Plan (2021-2026), injecting significant R&D support for funding new projects that will contribute to industry viability by resolving major agronomic and crop protection issues, and demonstrating competitive and sustainable production (Reynolds and Robinson, 2021).

Industry stakeholders representing the sesame industry have been grouped under the banner of the Australian Sesame Industry Development Association Limited (ASIDA), to act as a collective voice of industry.

Sesame has gained renewed interest in Australia as evidenced by the growers, seed technologies companies, agribusinesses and RDE organisations. Sesame seed technology companies such as Agriventis (Australia), Equinom (Israel), Agri Natura (Australia) and Sesaco (USA) have invested in black and white sesame variety evaluation, through businesses, university, department of primary industries and various cropping research providers have all contributed to the current knowledge base for growing sesame crops in Northern Australia. Seed companies such as AgriVentis Ltd provide a vertical integration model to drive action on the ground. This includes the provision of new genetics to seed lines, agronomic support by the Agriventis agronomy team and market linkage for Australian sesame. Agri-equipment companies such as RDO are well articulated to provide mechanisation support for planting, harvesting and seed process engineering. It is anticipated that improvements in cultivars, agronomy support and mechanisation technologies and post-processing investment will rapidly increase the production and productivity of sesame in Australia.



Challenges for Growing Sesame in Australia

Lack of Suitable Variety

As labour costs are excessively high for manual operation, Australian broadacre sesame farming is only feasible with mechanised production. The sesame varieties for Australian conditions should be suitable for combine harvester use. A few sesame varieties previously evaluated in Australia recorded very high harvest losses. Shatter resistant (non-dehiscent) sesame varieties are required for successful mechanised harvesting of sesame.

Equinom introduced non-shattering white sesame lines for Australia which are reported to have significantly lower machine harvest losses due to the non-dehiscence capsules of these new lines. These lines have been field evaluated in QLD and NT since 2016 and have been harvested mechanically. Successful sesame varieties for broadacre farming in Australia should also have strong drought tolerance. Current varieties introduced in Australia are generally medium to long duration varieties (120-150 days) which often suffer from terminal drought when planted in the tropical rainfall environment of northern Australia. Early maturity (<100 days), and dwarf sesame genotypes are generally drought escapers, therefore, such sesame traits should be evaluated for new genotypes of sesame for rainfed production in Australia.



Challenges for Growing Sesame in Australia

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Diseases

The sesame disease profile can change rapidly as the area under cropping expands since sesame crops are a recent introduction and all potential disease pathogens are not fully known. Common sesame diseases found in recent trial crops are Target spot (*Corynespora cassiicola*), Cercospora leaf spot (*Pseudocercospora sesamicola/Cercospora sesami*), Charcoal rot/dry rot (*Macrophomina phaseolina*), phyllody (caused by phytoplasma and transmitted through Jassids. Floral parts are transformed into green leafy structure followed by abundant vein clearing in different flower parts).

Insect/Pests

In Australia common insect pests recorded in trial sites are Bollworms, budworms (*Helioverpa spp*), Sesame leaf roller/leaf webber (*Antigastra catalaunalis*), green vegetable bug (*Nezera viridula*), green mirid bug and white flies (*Bemisia tabaci*).

A large number of other insect/pests challenges have also been reported from other sesame growing areas of the world, e.g. India where Gall fly (*Asphondylia sesami*) and Bud fly (*Dasineura sesami*), Sesame leafhopper (*Orosius albicinctus*), Hawk moth or Sphinx caterpillar (*Acherontia styx*), Hairy caterpillar (*Spilosoma obliqua*) cause significant damage to the sesame crops (Vikaspedia, 2022). Very limited chemicals are registered for the chemical control of these insects/pest challenges, both for the conventional and organic production systems.



Challenges for Growing Sesame in Australia

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Weeds

Sesame being a small-seeded crop, faces the issue of slow establishment, therefore, weed challenges in the early establishment phase is quite crucial for successful crops. As this crop is relatively new in northern Australia, the options for chemical control of weeds are very limited. The minor use permit for sesame herbicides for pre-emergent and post-emergent crops for the control of broad leaf weeds and grasses is given below:

Permit No.	Description	Issued date	Expiry date	Permit Holder
PER86672	Diquat / Pre-Harvest Desiccation in Sesame Crops	27-Aug-2018	31-Aug-2023	AOF
PER86673	Metolachlor Herbicides/ Control of Annual Grasses and Broadleaf Weeds in Sesame Seed	01-Feb-2019	28-Feb-2024	AOF
PER86783	Haloxyfop/ Control of Annual Grasses in Sesame Seeds	24-Jan-2019	31-Jan-2024	AOF
PER86796	Clethodim/ Control of Grasses in Sesame	03-Apr-2019	30-Apr-2024	AOF
PER86808	Pirimicarb/ Control of Aphids in Sesame	01-Feb-2019	28-Feb-2024	AOF
PER86901	Glyphosate/ Pre-Harvest Desiccation in Sesame Crops	18-Mar-2019	31-Mar-2024	AOF
PER86938	Diuron/ Control of Various Weeds in Sesame Seeds	27-Feb-2019	28-Feb-2022	AOF
PER12751	Fipronil & Fenitrothion for Control of Spur-Throated Locusts in Treed Roosting Sites in Proximity to Crops and Pastures	11-May-2011	30-Jun-2023	NSW DPI

Very limited information is available for weed control in organic production of sesame. Inter-row cultivation has been the practice followed by some of the current collaborating growers for sesame trials in central QLD.

(Source: Jones and Bodnaruk, 2020)



Challenges for Growing Sesame in Australia

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Agronomic Packages

Agronomic information regarding planting time for different climatic zones, density (plant population) of seeding, depth of seeding, seed treatment, early establishment success, nutrient and water use, and crop management practice, are very limited both for conventional and organic production system. Some of the current research projects and planned projects for 2022-2026 aim to address the agronomic challenges of sesame production in Australia.

Mechanisation

For planting large plots generally, the John Deere Maximerge type planter setup using JD part # 45 cell A43066 "Small milo disc" or 45 cell H136445 "Raw sugar beet disc" are common. "Knocker Assembly" #AH129125 is installed with each plate. For smaller plot planting, generally Monosem NG Plus Planter setup using a DC144-08 Plate with Light vacuum setting is followed for singulation of sesame seed at planting. A 72-cell plate restricts planter traveling speeds to below 4.0 kph.

Any well-maintained grain combine can be adapted for harvesting sesame. The most common header used in sesame is the conventional platform header. Auger headers allow sesame to stand up as it moves across the header and is then pulled in at the centre. Large draper headers appear to be very good at harvesting sesame, but the drapers used can result in the centre belt throwing sesame back out the front of the header. Harvesting at ground speed of 4-6 km/hour using a harvester fitted with a Harvestaire air reel and an extended table which gives a knife-to-auger distance as large as possible to provide the most efficient harvesting result.



Challenges for Growing Sesame in Australia

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Post-harvest handling and processing

Dedicated post-harvest processing for sesame seed cleaning and grading operation is currently lacking in Australia. Small bench top facilities for threshing, cleaning and grading have recently been established to support the processing of research seeds. Sesame seeds are often cleaned and graded in facilities designed for various pulses and grain crops (e.g. PB AgriFood, Allenden Seeds). No colour sorting methods for sesame seed have yet been established.

Sesame seeds produced have so far been marketed as unhulled seeds as there is no large scale sesame dehulling facility available in Australia. A small bench-top facility for sesame seed dehulling has recently been established in North Queensland to support the hulling of small quantities of research seeds and small volumes of sampling processing for commercial use at Savannah Sun Foods in Cairns.

Linkage to markets

Sesame seed produced in Australia so far have been exported to Malaysia and India as unhulled raw seeds. A number of small seed samples were sent overseas (Japan, Korea, China and Switzerland) for market testing by Agriventis Technologies Ltd, particularly for black sesame seeds. The Good Food Magazine in 2022 reported that Australia's first homegrown sesame seeds are now being served at a Melbourne restaurant (<https://www.goodfood.com.au/recipes/news/australias-first-homegrown-sesame-seeds-are-now-being-served-at-a-melbourne-restaurant-20220609-h24cph>). A strategic approach will be required for fast tracking of market and marketing arrangement for Australian produced sesame for the Australian domestic sesame markets.



Action on the Ground

Sesame seed production is an emerging industry in Australia. The market drivers are strongly in favor of home-grown sesame seeds and recent imports have reached 13,000 ton per annum with significant interest in extracting high value compounds including sesame protein for meat replacement. ASIDA, a peak industry body that has strong membership base (farmers, researchers, department of Ag, industries, seed business, processors) proactively engages with the whole of the sesame value chain and agencies to support industry aspirations of reaching 5,000 hectares under sesame producing 5,000 tons or more within four-years (2026), through the sesame project funded by AgriFutures and CRCNA.

There is strong need for local cleaning and grading capability as well as dehulling options for making locally grown sesame ready for domestic markets. Investment is needed in value adding activities involving local processing of sesame into high value products (e.g. black and white sesame oil, dips, snacks, protein concentrates etc).

Coordinated efforts are required for fast-tracking sesame RDE enabling growers to adopt sesame technologies in Australia. More on-farm and action oriented applied research is needed to fill the gap in sesame knowledge. The market should be the driver for all priority research activities, to support the momentum on commercialisation of sesame.



Way Forwards to Reach the Market

The way forward for market reach is driven by the RD&E plan. A strong focus on linkage with markets has been the priority for the seed technology companies. Mechanisation of sesame production under broad acre farming and the establishment of sesame processing facilities in Australia are going to be crucial for developing high quality sesame seeds that can be exported to other countries ***with a premium price for clean, green sesame*** from Australia.



Industry Development Perspective

ASIDA has been proactive in nurturing a collaborative approach between stakeholders for sesame industry development in Australia. The support from AgriFutures to implement the sesame RDE plan will translate the research to industrial scale commercial outcomes for this emerging industry, and also support industry capacity development for continuation of RDE in the future. A strong co-investment by the Industry, CRCNA and University funding has been very synergistic in terms of developing industry perspectives.



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