Broadacre Cropping in northern Australia

Issue 2, March 2021

- New webinar series #2 - March 2021
- Update from project leaders
- Introduction to new projects

In mid-2020, due to the travel restrictions related to COVID-19 the Cooperative Research Centre for Developing Northern Australia (CRCNA) and the Queensland (QLD) cropping projects held a virtual field day. This was a mammoth undertaking and attracted the attention of over 100 participants across Australia.

Following this virtual field day, the first issue of the Broadacre Cropping Newsletter was published, introduced each of the projects, consisting of a Project summary, Key messages, What's next and a Q&A section.

This second issue of the Broadacre Cropping Newsletter extends into the Northern Territory (NT), with the project "Spicing up the North" included in this edition.

You can find the virtual field day and first newsletter here:
https://crcna.com.au/resources/publications/broadacre-cropping-northern-queensland

Broadacre Cropping in northern Australia
Newsletter #2, January 2021
Contact: CroppingNA@gmail.com

The CRCNA acknowledges the support of its government partners.

Queensland Government
NORTHERN TERRITORY GOVERNMENT
Department of Primary Industries and Regional Development
GOVERNMENT OF WESTERN AUSTRALIA
Australian Government
Department of Industry, Science, Energy and Resources
Business Cooperative Research Centres Program

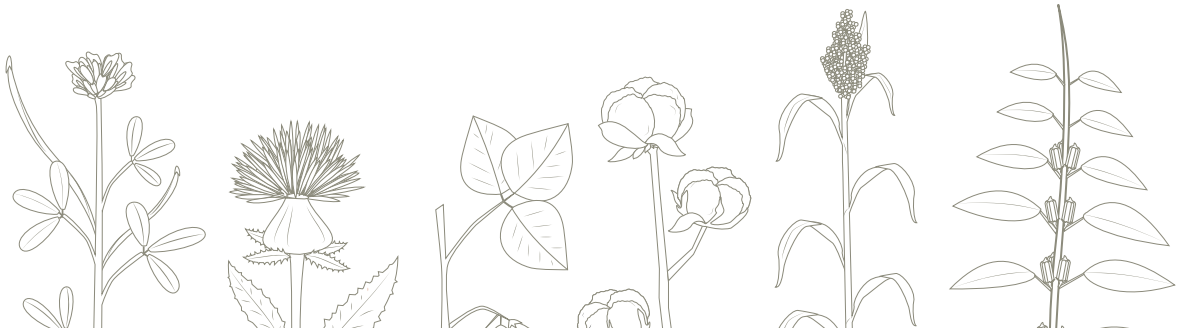
IN THIS ISSUE

Broadacre cropping in the north of Australia can be an important part of a farming business. Most value will be realised when broadacre cropping is integrated with existing agribusiness enterprises, particularly where it supports, boosts and diversifies beef production. The capacity to grow a range of crops in the north is clear but due to the barriers and risks of broadacre cropping in the tropics, farmers in the north should seriously consider leveraging crop production as part of a broader business value proposition to promote sustainability and business profitability. This will be achieved not where each individual crop must make a profit but where the viability and profitability of the whole farming system is raised.

Across northern Australia four broadacre cropping projects and one specific commodity (spices) cropping project are being co-funded by the CRC for Developing Northern Australia (CRCNA), Grains RDC (GRDC), Cotton RDC (CRDC), and other organisations and companies in the North. The CRCNA has co-invested with the Grains Research and Development Corporation (GRDC) in four broadacre cropping projects, three of which are in far north Queensland. The fourth project is a partnership between the CRCNA, GRDC and the Cotton Research and Development Corporation (CRDC) in the Northern Territory. Further, the CRCNA has partnered with Central Queensland University and several producers to deliver a commodity specific cropping project in central Queensland and the Northern Territory. Each of these five projects take a different emphasis to the issue of bringing broadacre cropping to diversify existing pastoral and farming enterprises of northern Australia.

This reimaging of broadacre cropping in northern Australia aims to take the lessons from previous broadacre cropping RD&E and combine this with contemporary crop species and varieties, adapt international and southern Australian farming technologies and knowledge to northern Australian systems and climates, use modern agricultural simulation tools, and link with up-to-date weather and soils information to assess the potential of northern Australian broadacre cropping. This will highlight the areas where additional information is required to de-risk investment in northern Australian broadacre agriculture.

From March 2021, the CRCNA will host a weekly webinar for each of the five projects and a final webinar to pull the five webinars together and provide a producer view of broadacre cropping in northern Australia. Northern Australian farmers will provide their experience and follow this with a panel discussion with the farmers and the researchers from the five projects.



WEBINAR **REIGSTRATION**

Seminars will be held on Wednesdays, 1:00 – 1:30pm

Click on the webinar title to open the registration link

10 **MAR**

De-risking broadacre cropping options for northern Queensland

Lead by Prof Daniel Rodriquez, Queensland Alliance for Agriculture and Food Innovation (QAAFI)

17 **MAR**

Developing a broadacre cropping sector in northern Queensland

Lead by Mr Graham Harris, DAF

24 **MAR**

Developing an oilseed industry in northern Australia

Lead by Nick Hill, Farmacist Pty. Ltd

31 **MAR**

Potential for broadacre cropping in the Northern Territory

Lead by Dr Matt Hall, DITT

7 **APR**

Spicing up northern Australia with high-value condiment crops

Lead by Dr Surya Bhattarai, CQU

GROUP WEBINAR 14 **APR**

A special one hour discussion and Q&A session with five growers and project leads on the industry development in northern Queensland and the Northern Territory.

If you experience any issues with registration email: croppingNA@gmail.com

DEVELOPING AN OILSEED INDUSTRY IN NORTHERN AUSTRALIA

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2020 has been a big year for the CRCNA funded Developing and oilseed industry for northern Australia project with winter, spring and summer trials established from Laura to Innisfail in north Queensland, and some interesting results produced.

2020 WINTER TRIAL OUTCOMES

To identify the fit for different oilseed crops within a furrow irrigated sugarcane winter fallow, trials were established between May and June at Biboorah north of Cairns. Trials investigated: the impact of time of sowing upon safflower, camelina and indian mustard; regional variety suitability for, nigella and fenugreek; and cultivar variety trials for carinata and linseed.

A major consideration for winter cropping in north Queensland is reduced yield outcomes linked to lack of soil moisture (due to dry season) and seasonal pest and disease pressure. The 2020 winter trial results confirmed these issues but also identified specific varieties, which were better suited to the seasonal conditions as well as options for "fine tuning" the system to be explored via further trial work.

The safflower and indian mustard time of sowing trials demonstrated that higher yields were achieved via an April/May sowing date, while Camelina has the potential for a variable sowing date without a yield penalty - however further trial work is required to confirm this outcome. These results are exciting as they provide the initial step in fine tuning the cropping system, allowing growers to successfully establish these crops within the optimal sowing window with an associated yield benefit. The linseed cultivar variety trial and the nigella and fenugreek regional variety demonstration identified a good regional fit with further investigation into irrigation requirements, time of sowing and options for disease control requiring further investigation. The stand out for the winter trial period was carinata. Following 3 years of trial work this cultivar has demonstrated tolerance to the winter "dry" and excellent pest and disease resistance, with specific varieties demonstrating increased yields. This outcome confidently provides north Queensland with its own "canola" which is a mainstay of southern oilseed cropping systems.

2020 SPRING TRIAL OUTCOMES

For the 2020 spring trials, black sesame, safflower and sunflowers were evaluated for their suitability for north Queensland commercial production. A new shatter resistant variety of black seasame allows it to be harvested via mechanical harvesting equipment which opens the door for north Queensland commercial production and access to a new global market. Outcomes were positive and a regional fit was identified as good yields were achieved. However, as with all new Cultivars further work into the agronomic requirements is needed to optimise production. Safflower is traditionally a winter crop and this trial looked to identify if time of sowing could be pushed back without penalising yield. Although a multitude of benefits of later sowing were identified, such as pest and disease resistance, good weed control options, and tolerance to increased sowing depth and limited soil moisture, yields were penalised due to the later sowing date. The sunflower trial investigated one variety, Barenbrug AusiClear20, due to its yield, market availability, rate of maturity and weed control options. Over the cropping cycle limited weed and disease pressure was noted but pest pressure and harvesting issues were encountered which made it hard to fully determine accurate yield outcomes. However, the crop was observed as being well adapted to the north Queensland cropping.

2020 SUMMER TRIAL OVERVIEW

This summer's focus for the oilseed project is soybeans. Soybean oil is a global commodity which has a multitude of benefits and uses and has been globally traded since 1951.

Within north Queensland cane farms legumes are widely accepted as an integral aspect of the farming system. Planted during the sugarcane fallow period legumes condition the soil, reduce pathogen counts, and add nitrogen resulting in reduced nitrogen fertiliser for the subsequent sugarcane crop. Together, these factors have a positive impact upon the growth of the following crop, increased farm gross margins and improved environmental water quality. Introducing soybeans into the cane farming system achieves the same outcomes whilst providing further economic benefit via the introduction of a profitable oilseed cash crop. Empowering traditional sugarcane growers with the locally focused information required to successfully take a crop to a maximised harvest is a major component in increasing soybean yields with the view to facilitating the establishment of a direct path to market.

Summer soybean trials have been established in both the Burdekin and Central regions to address the concerns and queries raised by sugarcane farmers for locally relevant issues.

Not often thought of as an oilseed cropping zone, the Central region is predominantly sown to sugarcane. However, the need to maintain Smartcane Best Management Practice standards and achieve economic benefits has growers keenly interested in growing soybeans. With the recent influx of new varieties and the lack of variety specific information targeted to the Central region, grower representatives have asked for a simple trial to address one question: "what is the best sowing rate for these new varieties".

Plant population densities under investigation are: 200,000, 250,000, 300,000 and 350,000 plants per ha which will be applied to three varieties of interest: Kuranda, New Bunya and Mossman, with the outcomes compared to Leichhardt which, due to its established history in the region, will be used as an indicator variety. The trial consists of four replicates of each treatment in a Latin square design to address infield variability (Figure 1).

The Burdekin is a powerhouse of agricultural production being Australia's largest sugarcane growing region and home to a diversity of horticultural crops. Soybeans are not new to the Burdekin however locally specific information is needed to facilitate the further establishment of soybeans and maximise production outcomes. A key component of this is varietal response to time of sowing as well as identifying a best fit for new varieties to assess their suitability for this unique agro-ecological zone.

2	1	11	v	3	14	8	10
7	10	4	13	6	1	11	15
9	8	14	3	16	12	2	5
12	15	5	6	9	7	13	4
5	11	8	1	2	15	7	3
14	4	2	7	11	5	9	6
3	13	15	12	8	10	16	12
16	6	9	10	13	4	14	1

Variety/Treatment Number				
Sowing rate	Kuranda	Mossman	New Bunya	Leichart
200,000	1	5	9	13
250,000	2	6	10	14
300,000	3	7	11	15
350,000	4	8	12	16

Figure 1. Central region soybean variety by sowing rate trial.

Within the Burdekin trial soybean varieties: Kuranda, Hayman and New Bunya and three experimental varieties are being subjected to two different times of sowing (Figure 2) to identify a best fit for the sugarcane rotation and the associated impact upon soybean yield. The introduction of the experimental varieties will further assess levels of disease resistance and their suitability to this unique region within nominated times of sowing.

TOS 1		TOS 2		TOS 2		TOS 1		TOS 2		TOS 1	
Hayman	New Bunya	Exp variety 3	Exp variety 1	Exp variety 3	Exp variety 1	Exp variety 3	Exp variety 2	Kuranda	Exp variety 2	Hayman	Kuranda
Exp variety 3	Kuranda	Exp variety 2	Kuranda	Hayman	Exp variety 2	New Bunya	Hayman	Exp variety 1	New Bunya	Exp variety 1	Exp variety 3
Exp variety 2	Exp variety 1	New Bunya	Hayman	Kuranda	New Bunya	Kuranda	Exp variety 1	Hayman	Exp variety 3	Exp variety 2	New Bunya

Figure 2. Burdekin region soybean Time of Sowing by Variety

DEVELOPING A BROADACRE CROPPING SECTOR IN NORTHERN QUEENSLAND

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A key issue limiting investment in grain cropping systems within northern Australia is an understanding of the yield variability (and hence risk profile) and profitability of grain crops that could be grown within existing extensive grazing systems. There is also limited knowledge and experience amongst landholders and the agribusiness sector with the agronomy of grain crops within the region.

The project team have established an on-farm research site west of Georgetown on Forest Home Station in collaboration with Fry Bloodline Trust. This site is representative of the 20,000 ha of potential irrigable soils within the Gilbert River catchment. The site is fully fenced and irrigated.

Replicated research trials of cotton, soybean, mungbean and sesame were planted in the 2020 cropping season. These trials are being repeated in the 2021 season. They build upon the results of the earlier trials of these crops by the Department of Agriculture and Fisheries in the 2018 and 2019 seasons.

Table 1 summarises the varieties/lines and treatments investigated at the Forest Home trial sites over the past three years. The cotton trials have focused on three full season Bollgard®3 stacked with Roundup Ready Flex varieties. These have characteristics which provide weed management options and Bollgard® technology to aid Helicoverpa management. The three varieties also differ in their response to water stress. In the 2019 and 2020 seasons with and without growth regulant treatments were applied to assess its use to manage potential excessive growth in this environment.

The commercial mungbean varieties Crystal and Jade-AU were trialled in the 2018 and 2020 seasons. In 2019 potential new mungbean lines from the DAF breeding program were assessed (M11236 and M12036) together with four AgriVentis mungbean lines.

In 2018 the soybean varieties – A6785 and Stuart – were planted in an irrigated trial. In 2019, the newer varieties Kuranda HB1 and Mossman HB1 were compared under irrigated and raingrown conditions. Kuranda HB1 is a broadly adapted, medium to long duration variety with higher yield potential than A6785 and Stuart. It has a clear hilum making it attractive for use in high value human consumption markets. Mossman HB1 is a long duration variety producing a light coloured hilum – providing access to some human consumption markets. Kuranda and Mossman were again planted in 2020, but this trial was abandoned due to poor crop establishment and subsequent weed competition.

Various sesame lines (white and black seeded types) have been planted in each of the past three seasons. Trials were successfully harvested in 2018 and 2019. In 2020 excessive weed competition – a result of the late wet season break – resulted in abandonment of the trial. Sesame is a poor competitor with weeds in the first 30 days after emergence. This needs to be taken into account when selecting fields for planting to sesame. Currently the Department of Agriculture and Fisheries are conducting preliminary herbicide screening trials for sesame.

Table 1 Crop variety and lines and treatments imposed at Forest Home trial sites – 2018, 2019 and 2020

Crop	2018		2019		2020	
Cotton	Variety	Regulant	Variety	Regulant	Variety	Regulant
	Sicot 714B3F	-	Sicot 714B3F	-	Sicot 714B3F	-
				+		+
	Sicot 746B3F	-	Sicot 746B3F	-	Sicot 746B3F	-
				+		+
	Sicot 748B3F	-	Sicot 748B3F	-	Sicot 748B3F	-
				+		+
Mungbean	Variety		Line		Variety	
	Crystal		M11236		Crystal	
	Jade-AU		M12036		Jade-AU	
			AVYMB-1			
			AVYMB-2			
			AVYMB-3			
			AVYMB-4			
Soybean	Variety	Irrigation	Variety	Irrigation	Variety	Irrigation
	A6785	+	Kuranda PB1	+	Kuranda PB1	+
				-		
	Stuart	+	Mossman PB1	+	Mossman PB1	+
				-		
Sesame	Line		Line		Line	
	6821		S8655		S8655	
	6824		S8658		S8658	
	6825		Black Patch		Black Patch	
	6835		Moria Black		Moria Black	

The yield results for the cotton trials (where growth regulant was not used) are summarised in Figure 1. These trials show that in the best seasons yields of 9 to 11 bales/ha are achievable. They also suggest that in more difficult seasons a yield of around 8 bales/ha is possible. If half of the potential irrigable area was planted to cotton (10,000ha), and assuming a price of $500/bale, the potential revenue from cotton in this district would be in the order of $40m (at 8 bales/ha) to $50m (at 10 bales/ha) per annum. In addition, this would produce around 27,000 to 34,000 tonne of cottonseed for the local cattle industry.

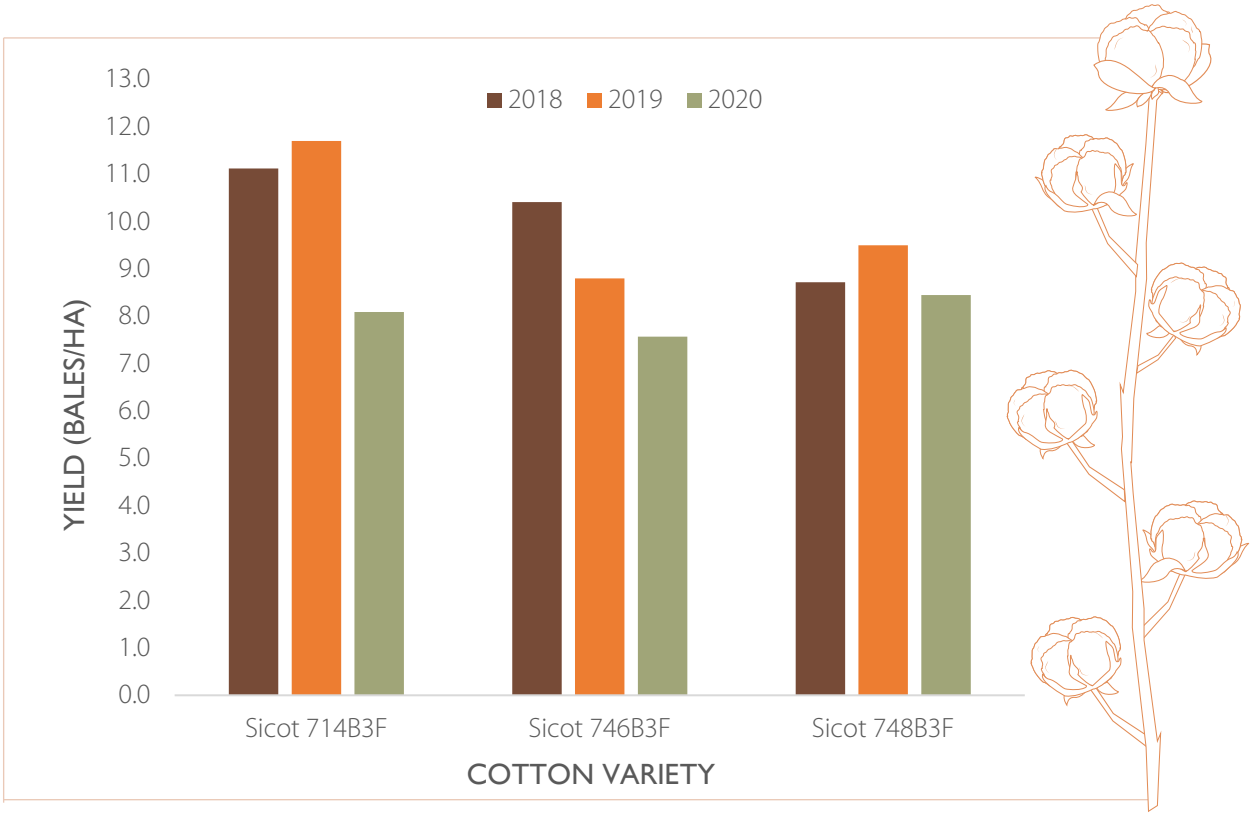

Figure 1 Yield results for cotton variety trial at Forest Home Station – 2018, 2019 and 2020

The results for other crops in the trials appear promising. Mungbean yields have ranged between 1.0 and 2.5 t/ha, with soybean yields of 1.6 t/ha (dryland) to 3.9 t/ha (irrigated). The yields of sesame have ranged from 1.8 to 2.6 t/ha to date.

Trials in the current 2021 season and next year will provide further yield and agronomic information on the performance of these crop options in the region. The data collected from these trials will be used to validate the APSIM crop model for this region. APSIM will be used to provide an understanding of the yield variability and associated production risks with growing these crops in the region. This information will be used to assess the profitability of broadacre cropping here and develop agronomic guidelines for the production of these crops. This understanding will enable potential croppers to assess the viability of developing a broadacre cropping industry that will benefit local landholders and the wider community.

The project team would like to acknowledge the funding support of CRCNA and GRDC, the members of the Gilbert River Stakeholder Reference Group, and Ken and Brendan Fry for their invaluable assistance in the conduct of the research trials on Forest Home Station over the past three seasons.

DE-RISKING BROADACRE CROPPING OPTIONS FOR NORTHERN QUEENSLAND

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KEY RESULTS FROM THE 2020 SEASON

SOIL INFILTRATION AND RAINFALL HARVESTING

The use of Desmanthus, a perennial legume shrub, in intercropping systems with grain sorghum showed great potential to increase ground cover during the dry season and increase the forage value of the sorghum stubble in predominantly rangeland grazing businesses. Improved Desmanthus establishment practices will be required for the sandy loamy soils of the Gilbert region.

Photos. (Left to Right) J Eyre determining water infiltration at Prestwood Station, Desmanthus growing in sorghum stubble, Reg and Bev Petracini from Prestwood Station discussing the results on soil infiltration in sorghum stubble, Desmanthus growing at Prestwood Station, Georgetown.

BETTER ADAPTED SUMMER GRAIN VARIETIES:

At both "Curra" Kilcummin (Figure 1) and "Manar" Capella (Figure 2), some new experimental red, white and high digestibility grain sorghum hybrids produced grain yields similar or high than the yields from the commercial check hybrids. Yield differences of up to 4t/ha were recorded. Figures 2 and 3 also show that six of the experimental hybrids coincided as the highest yielding hybrids (top yielding tercile) at both sites (this is hybrids 100404, 100481, Rex013, 100412, 100477 and Rex012), all yielding over 4t/ha at Kilcummin, and over 3.7t/ha at Capella. At Kilcummin the two highest yielding commercial hybrids were Agitator and Brazen from Radical Seeds Australia (yielding just over 4t/ha), these are hybrids adapted to Central Queensland environments. At Capella the highest yielding commercial hybrids were A75 from Pioneer and MR Buster from Pacific Seeds. Caution should be exercised as these are results from a first year of trials. These trials will be repeated this coming season to help build a more robust understanding of best performing hybrid types and yield drivers across sites and seasons.

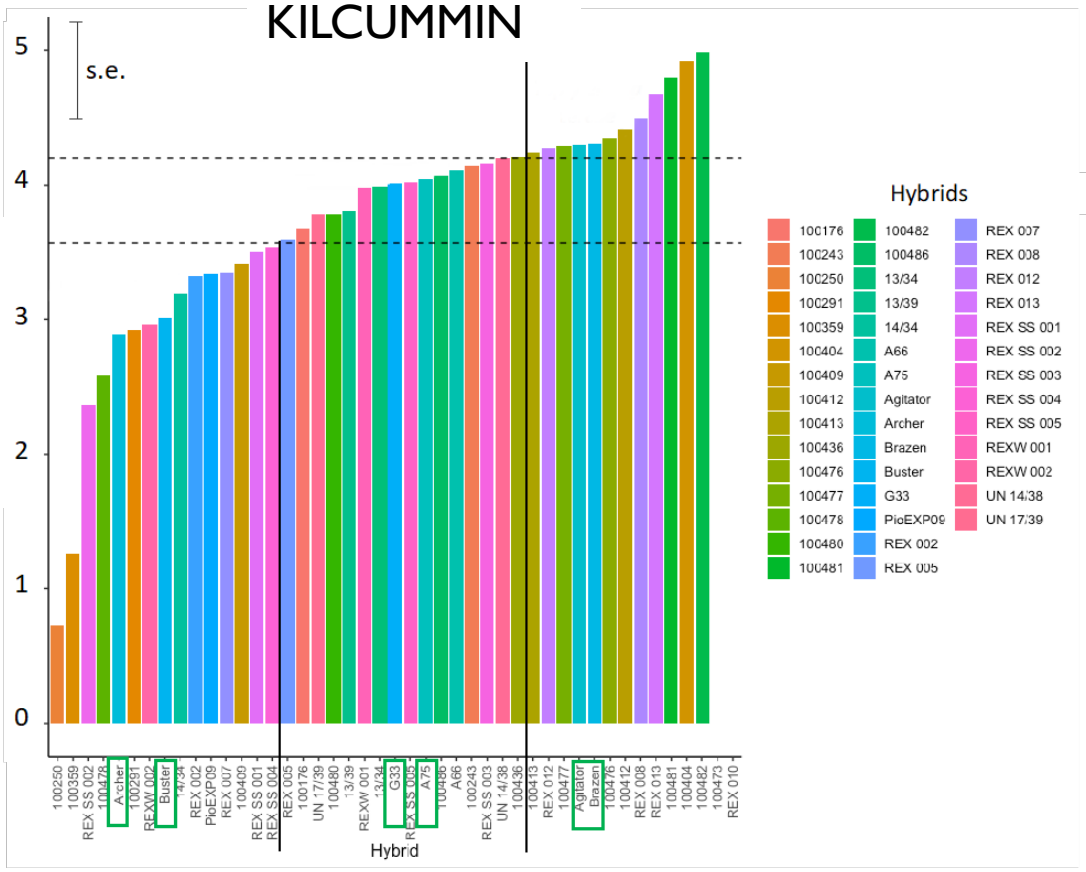

Figure 1. Mean yields for the different hybrids tested at "Curra" Kilcummin, Qld during the 2019/20 season.

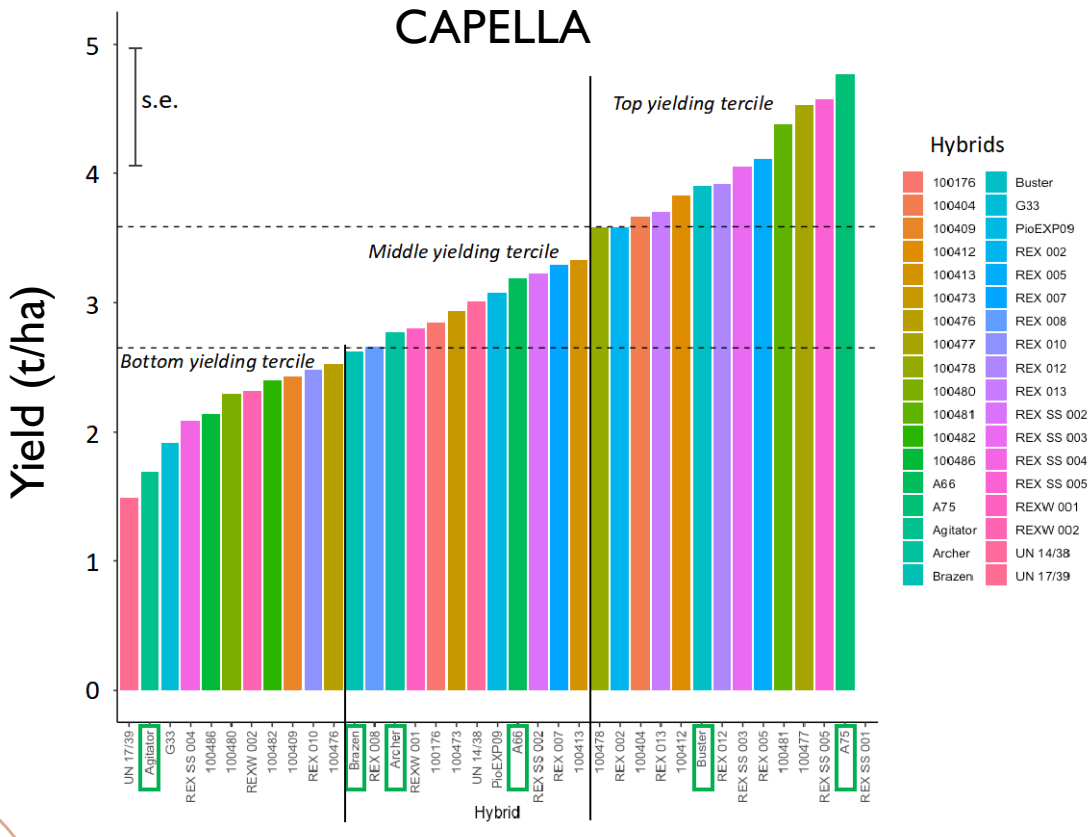

Figure 2. Mean yields for the different hybrids tested at "Manar" Capella, Qld during the 2019/20 season.

CROP NUTRITION

Two replicated trials were sown using one hybrid (G33) and six fertiliser treatments including current practice (farmers practice differed between sites), four nitrogen (N) rates and two N sources. The two identical trials were planted at "Prestwood Station" (Georgetown) and "Curra" (Kilcummin). Treatments included a control with no fertilisation, three levels of N fertilisation using a liquid N product from Incitec Pivot (Easy N) plus a basal level of a starter fertiliser (Start UP ZN), and a biological active liquid fertiliser produced by Australia Soil Planners (ASPLF) as an alternative "biological" fertiliser (Table 1). The level of N in the application of starter fertiliser was equivalent to current farmers' practice ~ 8 kg N/ha.

Table 1. List of treatments for the crop nutrition farmer driven trial at "Curra" and "Prestwood Station.

Treatment	Easy N (l/ha)	Start UP ZN (l/ha)	ASPLF (l/ha)
0 kg N/ha Control	0	0	0
8 kg N/ha (starter only)	0	86	0
54 kg N/ha + starter	100	86	0
100 kg N/ha + starter	200	86	0
192 kg N/ha + starter	400	86	0
Biological (ASPLF)	0	0	80

The results from the first season of trials at "Prestwood Station" need to be considered with caution, given the extremely dry conditions experienced by crops in the Gilbert. Having said that, the nutrient responses from "Prestwood Station" in Georgetown (Figure 3 left) and "Curra" in Kilcummin (Figure 3 right), showed clear similarities. In Georgetown, yields exceeded expectations for such as harsh rainfall season. Grain sorghum crop residues defined as total above ground biomass without grain, averaged 3 t/ha at Prestwood Station. At Kilcummin grain yields increased by 16.5% when nitrogen inputs were increased from 0 to 54 kg/ha, then plateau with 100 kgN/ha, and declined with 192 kgN/ha. The decline in yields was probably driven by excessive early growth and water use during vegetative stages.

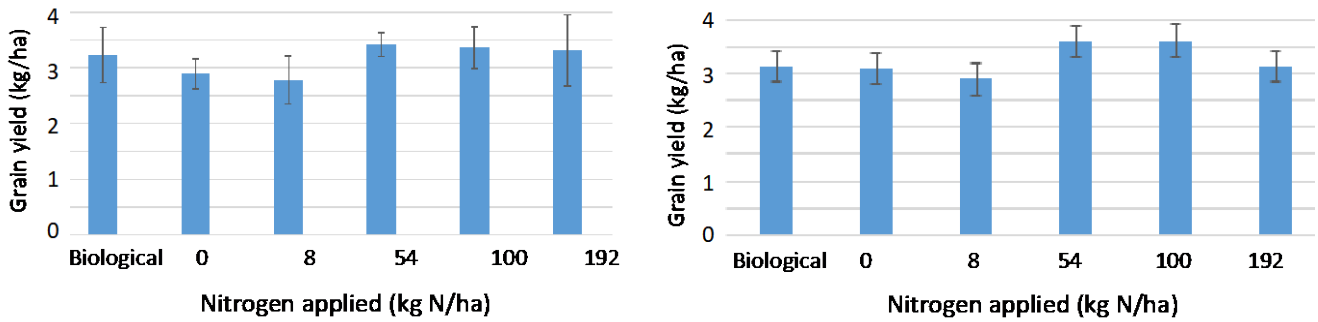

Figure 3. Grain yields from sorghum's nutrition trial at "Prestwood Station" (left), Georgetown and at "Curra", Kilcummin (right). See Table 1 for treatment descriptions.

Soil spatial variability remains a significant challenge, particularly rainfall infiltration and subsoil constraints such as salinity and sodicity at depth. Results from soil tests of the Gilbert region identified that most soils across the region show low levels of carbon and nutrients. However, the well-known dry spells, hot weather, and the poor soil water holding capacity and soil structure of most soils will limit yield responses to nutrient increases.

SPICING UP NORTHERN AUSTRALIA WITH HIGH-VALUE CONDIMENT CROPS

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PROJECT BACKGROUND "SPICING UP NORTHERN AUSTRALIA"

The changing face of northern Australian farming systems could include high-value condiment crops as the CRCNA, CQUniversity and AgriVentis Technologies, test the suitability of five different spice crops to a range of different environmental conditions and production systems. The spice industry is valued $30 billion globally and currently Australia imports most spices at a value of AUD$500M annually. It is expected that the demand for spices will increase across Australia due to a diverse multicultural population and changing consumer preferences. The northern Australian climate is favourable for spice production, offering an opportunity for growers to diversify their production. The Spicing Up the North project is assessing black sesame, fennel, cumin, kalonji (nigella) and kalijiri for commercial production and sale through AgriVentis Technologies.

The first year of the project (2019-2020 season) consisted of small plot trials in Biloela, Rockhampton, Ayr, Tully, Darwin and Katherine (Figure. 1), covering a diversity of agroecological zones in northern Australia. Black sesame and fennel varieties were trialed in summer, and cumin, kalonji and kalijiri in winter. The results of the small plot trials, including quantity and quality metrics, have directed the selection of lines for larger-scale field trials in year two. Two black sesame varieties (AVTBS#6 and AVTBS#11) were selected to be grown in each of the six locations and in the Ord in WA in the 2020/2021 summer season. This summer planting is at a scale of approximately 1ha with an increased number of commercial producers growing the crop this year, in addition to the original research trial sites. Planning is currently underway to determine the best crops and varieties to carry through for planting in the 2021 winter season, with additional growers to again be engaged to plant up to 1ha of the best performing crops and varieties in each region.

Figure 1. Trial locations in northern Australia

BLACK SESAME (*SESAMUM INDICUM*)

Black sesame is a high-value product returning US$1229/t in 2018, which is about 45% more than white sesame. Australia's domestic demand is consistently increasing, and this, coupled with a significant global demand for black sesame, brings a new opportunity for northern Australian growers. The crop has showed wide adaptability, demonstrating its potential to fit into cotton or sugarcane farming systems. The crop is known for its drought and heat tolerance making it a desirable crop choice for the environmental challenges experienced in the North.

Table 1. Seed yield (t/ha) of four black sesame varieties planted in Qld and NT during 2019/20 summer season.

Varieties	QUEENSLAND				NORTHERN TERRITORY		Mean
	Biloela	Rockhampton	Ayr	Tully	Darwin	Katherine	
AVTBS #3	2.748	2.83 a	1.578	1.392	1.076 b	2.011	1.826
AVTBS #6	3.315	3.23 a	1.596	1.393	1.687 a	1.991	2.073
AVTBS #11	3.177	3.06 a	1.786	1.569	1.672 a	1.714	2.045
AVTBS #16	2.933	1.81 b	1.424	1.111	1.682 a	1.926	1.750
Mean	3.043	2.73	1.596	1.366	1.529	1.911	
P value	0.064	0.032	0.395	0.435	0.009	0.498	
LSD	0.437	0.906	0.439	0.5995	0.3749	0.4570	

(NB. The yield values with different letters indicates statistical significance between varieties of each location.)

The 2019/20 small crop trial showed that crop duration for black sesame is about 90-120 days from planting to harvest, with the NT locations having a shorter growing season than most Qld grown crops (Figure 2). The plant height was 150-200cm with the position of the first capsule 60-150cms from the ground.

The hand-harvested seed yield of the four varieties across each of the trial locations, from 1.37 to 3.04t/ha, with the highest seed yield recorded in Biloela followed by Rockhampton, Katherine, Ayr, and Darwin, and the lowest yield recorded in Tully (Table 1). This is significantly higher than the global average of 554kg/ha. However, it is important to bear in mind this is one year's data only. The crop produced significant biomass in the range of 3-10t/ha. This volume of biomass creates an opportunity for value-adding, with biomass waste being able to be used for briquettes and harvesting of antioxidants.

While the early results are encouraging, there are challenges that need to be addressed for full-fledged production, including weed control, optimisation of mechanical harvesting, and providing robust agronomic information especially concerning optimum planting times at the different regions and density of planting.

Figure 2. The growth stages of the black sesame crop at the Rockhampton site: a. seedling establishment; b. vegetative growth at one month; c. vegetative growth at six weeks; d. budding; e. flowering; f. mature pods; and g. dried and shattered pods (Images: T. Trotter).

FENNEL (*FOENICULUM VULGARE*)

In 2018, Australia imported 568t of spices in the broader fennel group, worth about US$1.37M. The majority were produced in India and China (UN Com Trade, 2019). Calculations made by CQUniversity using trend analysis suggest that in 2025 the demand in Australia for fennel and other similar spices will exceed 2000t/year.

The results from the 2019/20 small crop trial indicate that fennel suffered from heat at during germination resulting in the crop failing in Darwin and Tully and needing to be replanted in Biloela. The crop duration for fennel ranged from 194-255 days from planting to harvest. This is a long-season crop (particularly for summer planted crops), but it shows promise as a perennial which might be able to be harvested more than once. The results also indicate that fennel might be more suited to winter planting in northern Australia and it will be added to the winter spice group for planting on a larger scale in 2021.

The seed yield of the three varieties across each of the four trial locations, ranged from 50 to 1574kg/ha (Table 2). The fennel crop produced biomass in the range of 525 to 9997kg/ha.

Table 2. Seed yield (kg/ha) of three fennel varieties planted at different locations in QLD and NT during 2019-20 cropping season.

Varieties	QUEENSLAND			NORTHERN TERRITORY	Mean
	Biloela	Rockhampton	Ayr	Katherine	
AVTFS #1	305	959	1574 a	1213	1013
AVTFS #2	373	521	996 b	1052	736
AVTFS #3	420	1212	50 c	904	647
Mean	366	880	1131	1056	858
P value	0.678	0.194	0.002	0.458	
LSD	282.6	1001.0	296.1	520.5	

(NB. The yield values with different letters indicates statistical significance between varieties of each location.)

KALONJI *(NIGELLA SATIVA)*

Kalonji (*Nigella sativa L.*) is a small herb, also commonly known as black cumin, black seed or Nigella. In 2018, Turkey produced 3300 tonnes of kalonji with an average yield of 980kg/ha. When planted between May and June, the kalonji took 105-148 days until harvest. The crop maturity was faster in the northern locations compared to the south. The seed yield varies very greatly between the sites. The lowest yield was recorded in Darwin, whereas highest seed yield of 3t/ha recorded in Biloela (Figure 4). Yield was impacted mostly by site, not variety indicating that the southern areas are better suited to kalonji production.

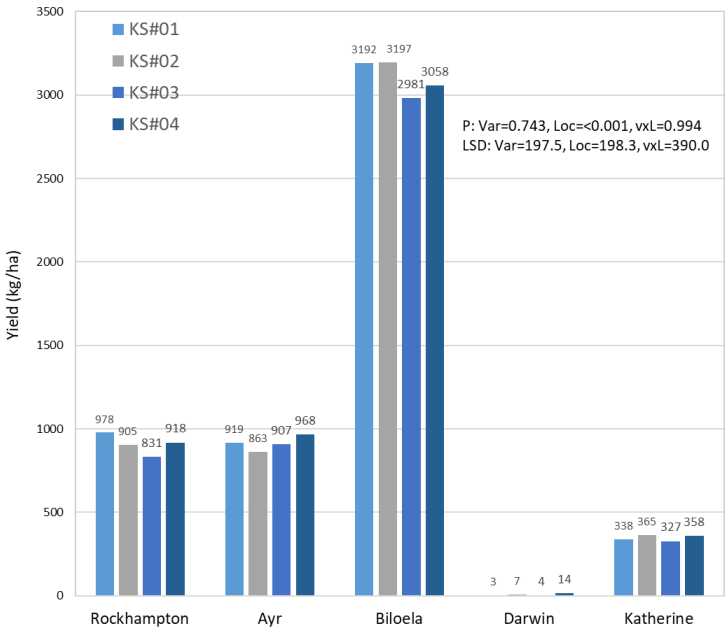

Figure 4. The variety by location (environment) interaction for seed yield (kg/ha) for four kalonji genotypes tested over five different production environments across QLD and NT.

Image 1. Small plot varietal trial of kalonji grown in Rockhampton,

KALONJI *(NIGELLA SATIVA)* CONTINUED

The kalonji crop failed in Tully and no crop was harvested. Although there was good germination of kalonji in both Darwin and Tully, the winter season appeared to be too warm to produce a crop. The plants that emerged did not produce much vegetative biomass, flowered early and produced little or no harvestable yield.

These data suggest that kalonji is better suited to winter cropping in Central Queensland, where the night and day time temperatures are milder and less humid than northern Queensland and the northern parts of the NT. The crop grown in CQ was robust, uniform and showed good potential for mechanical harvesting.

There was minimal observed damage to the crop at any of the sites from pests or disease, although there was some evidence of rodent activity in the crop at Biloela. This crop could form part of a rotation with cereals grown in winter in the CQ region, providing a high-value option for producers looking to produce an alternative crop.

CUMIN (*CUMINUM CYMINUM*)

The small plot trial for cumin was planted between mid-May to mid-June 2020, with the duration from planting to harvest 104-155 days. Cumin germination and seedling establishment is known to be more successful in cooler climates and grew well in Central (Image 2). The cumin trial crop established in four out of six sites planted as the crop at Tully and Darwin did not establish to produce a harvestable yield. The recorded seed yield of cumin ranged from 319-728 kg/ha. The seed yield within locations for the varieties did not vary significantly (Figure 6). The world average yield for cumin is 600-800kg/ha and so the yield recorded in this trial for Rockhampton is the only site on par with the world average.

Cumin yield could be improved by optimising the agronomy, with further investigations required into nutrient management, control of diseases and weeds, as well as optimisation of density and time of planting. However, at this stage the crop appears only suited to Central Queensland.

Image 2. Small plot varietal trial of kalonji grown in Rockhampton, winter of 2020.

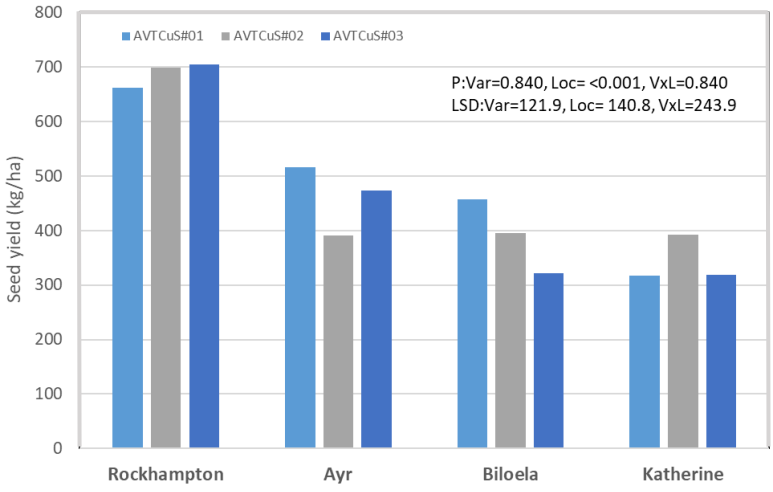

Figure 5. The cumin small plot trial grown in Biloela in winter 2020.

CONCLUSIONS

Black sesame currently shows the most promise as a high-value crop which yields well and could be used in rotation across the whole of northern Australia in summer, and may also be an option in far north Queensland and the Northern Territory in winter when grown on stored soil moisture or supported by irrigation in the dry season. Optimising harvesting of the crop is a challenge which will be investigated to reduce harvest losses caused by pod shattering. The timing of defoliants with harvest or the use of pod sealants are likely to be the key to harvest success in the short term.

The spices grown over winter showed varied success, with greater potential for these crops in Central Queensland. Kalonji showed great promise, being a uniform crop which appeared to have an ideal structure for machine harvesting, where the planting and harvesting equipment owned by producers who produce cereal crops could be utilised. Kalonji could be a great high value crop grown in rotation in these areas.

Cumin will require additional work to improve yields to make this a viable crop in northern Australia. Additional research particularly into controlling disease pressure (powdery mildew) is recommended before this becomes a commercial option.

There could be an opportunity for fennel production in north Queensland and Darwin during winter, if the crop is sown into stored soil moisture after the wet season and grown through the dry winter season. It is expected that the crop duration would be shorter if grown over winter as the plants would dry off in the heat of spring and early summer, allowing for harvest before the onset of the wet season.

POTENTIAL FOR BROADACRE CROPPING IN THE NORTHERN TERRITORY

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The development of a profitable and sustainable cropping industry in the Northern Territory has been bolstered by the initiation and ongoing development of the NT broadacre cropping project.

The Project will collate historical broadacre cropping data, natural resource information and an understanding of market opportunities to support the development of viable broadacre cropping systems in the NT. This is being achieved by project participants each bringing unique expertise and experiences to develop crop management strategies which will help to de-risk broadacre agriculture in the Top End.

The initial focus of this project will be on dryland and irrigated systems growing cotton and peanut crops, while other crops such as sorghum, rice and pulse crops will also be investigated as possible 'break crop' options for cotton and peanut producers. A mixture of on-field and simulation techniques will be used throughout this project.

On-farm demonstration crop plots planted on commercial properties will serve two purposes:

1. experience for the producer and extension site for promoting agricultural method to local producers.
2. testing of the crop simulation models

The project has created both interest in the development of a viable cropping industry in the north and provided a conduit for farmers and interested stakeholders to come together, discuss issues and opportunities that will enable and promote the ability to create a new industry that can create real regional economic development opportunities and assist in the intensification of the beef industry, which is the leading agricultural industry in the NT.

There is work to be done on broadacre cropping becoming integrated with existing agribusiness enterprises, particularly where it supports, boosts and diversifies beef production. There is capacity to grow a range of crops in the Northern Territory, but the driver looks to be the utilisation of cotton as a cornerstone crop to reduce the barriers and risks of broadacre cropping in the tropics. The return on capital from cotton will allow for the establishment of critical industry mass, which will support the development of supporting infrastructure, including a cotton gin.

On the back of this development, farmers in the NT can seriously consider leveraging crop production as part of a broader business value proposition to promote sustainability and business profitability, or in some cases we will see dedicated cropping farming families relocate to the NT to access land and water for business expansion. An additional benefit of the cornerstone crop (cotton) being processed in the NT, will be the availability of a ready protein source for animal feed, which will stimulate cropping development, further improving the viability and profitability of the whole farming system in the North.

Top left: Douglas Daly cotton; Top right: Sam McBean examining harvested cotton July 20', Bottom right: Planting cotton Douglas Station, Jan 21', Bottom left: Hands on Agriculture irrigated cotton July 20'

The project has had a great start with seven wet season plantings of cotton in the Katherine, Douglas Daly region in the 2020 season (which was one of the driest on record). The farmers, many having no cotton experience, learnt significant amounts from the strong interest from the wider cotton industry's inclusive nature and from the other farmers practices. The cropping project acted as a conduit to bring farmers, researchers, and the wider industry together. With several field days and crop walks creating strong interest and very well attended by farmers, potential farmers and interested stakeholders. Attendance ranged from 30 to over 80 people at the various events including a very successful IPM field day at Douglas Daly Research Farm on the 6th of March 2020.

In the first year, the dryland cotton yields were reasonable for what was one of the driest wet seasons on record, more importantly all farmers could see how yields could be improved through modifying farming practices. All farmers were looking to build on this experience with plantings in the 2021 season. The yields in Douglas Daly/Tipperary ranged between 3-6 bales/ha, with Katherine yields being 1.9 bales/ha ginned for the dryland crops.

On the quality front, Douglas Daly/Tipperary quality was generally acceptable to good, with some samples returning a high micronaire and some short staple length. There was a discount of between $0-25/bale on ginned bales. The Katherine cotton had short staple as the major issue with an average discount $80/bale, it is believed that this was due to poor preparation, very poor wet season, and the dry March early finish to the wet season. With the irrigated crops, the Douglas Daly yields ranged between 8.5-9.5 bales/ha and the Tipperary crops yielded between 6.9-8.5 bales/ha. All the irrigated crops returned good quality cotton with a slight discounting for micronaire issues causing a discount range of $0-10/bale.

All growers had significant learning from the 2020 season, these included:

- a need to combat high soil temperatures during the planting window
- need to establish ground cover to sow into
- need for a range of planting dates, plant densities and ground preparation variations.

Growers have commented, based on results to date, that there is an opportunity to trial a range of different regimes for next season as local growers look to adapt current cotton management to NT conditions, these include:

- plant density, especially lower density for cotton
- spreading planting dates from mid-December (dryland) to end of January
- increasing the amount of ground cover to sow into
- fertiliser rates and timing.

The 2021 wet season crop will be another great milestone in the development of the Northern Cropping Industry with more farmers and significantly expanded areas of cotton production in what is forecast to be an above average wet season that will give farmers a new range of conditions to adapt to. At this stage all of the 2021 (with dryland crops planted from 15th of December to 5th of February and irrigated crops planted from late-January to mid-February) crops are looking very good in all locations under significantly different climatic conditions to 2020.

For the 2021 season, growers have adapted the plantings with a significant diversity of plant density, spread of planting dates, increasing the amount of ground cover along with modified fertiliser rates and timing. This along with the increased rainfall (falls to date are above the total for the 2020 season) are sure to give growers (and the crop modelling) a range of results to continue to develop the cropping system. The 2021 season will also see several other crops added to the potential cropping system including grain sorghum, sesame, rice and a range of fodder crops.

Cotton at Scott Creek February 2, 2021, planted December 20, 2020

Cotton at Edith Springs Station, Katherine February 10, 2021, planted January 1, 2021.

Central Australia plantings have been expanded with increased areas of peanuts going in the ground at Ali Curung, along with plantings mungbeans and cowpeas at other sites. There have been some teething problems in the plantings, but with increased confidence growers and agronomists are looking to develop the cropping system for these new areas. Peanuts are now in the third round of plantings in the ground with multiple varieties being planted in commercial sized plantings in January 2020, October 2020 and January 2021.

With the mungbeans, cowpeas and peanuts (along with other potential crops of hemp, soybeans, chickpeas with other grain and fodder crops) there looks to be a great synergy with integration into a cropping system as a good rotation with the established irrigated rhodes grass production and a range of higher value horticultural crops.

Harvest June 2020

January 2021

January 2021, planted October 2020

January 2021

The expanding opportunities along with the successes and learnings from the current round of cropping will increase the confidence of potential producers to diversify their pastoral businesses or sub lease and intensify small sections of their land resource for cropping production.

One of the main aims of the project is to provide strategic information to de-risking of crop development on selected sites and guide the further selection of potential sites across the NT and broader northern Australia.

By the end of the project, it is expected that there will be an expansion of the natural resource database files for use in cropping simulations and have better developed processes which will enable interrogation of this data by interested parties. This will allow for a greater understanding of the wet season start and end dates, including any variation of the wet season length and rainfall distribution within a wet season.

Understanding the length of a crop window aids selection of the appropriate crop for that season and when linked to known markets, allows the farmer to have an understanding of the possible return for a particular crop to match that season's crop window and different regions of the Northern Territory and the greater northern potential production zones.

Authored by Andrew Philip, NT Farmers Association

Questions regarding webinar registration or newsletter content, please contact: croppingNA@gmail.com

Further information on the projects listed are available on the CRCNA Website (see links below):

- Developing an oilseed industry in northern Australia

  https://crcna.com.au/research/projects/developing-oilseed-industry-northern-Australia

- Developing a broadacre cropping sector in northern Queensland

  https://crcna.com.au/research/projects/developing-broadacre-cropping-sector-northern-queensland

- De-risking broadacre cropping options for northern Queensland

  https://www.crcna.com.au/research/projects/de-risking-broadacre-cropping-options-northern-queensland

- Spicing up northern Australia with high-value condiment crops

  https://crcna.com.au/research/projects/spicing-northern-australia-high-value-condiment-crops

- Potential for broadacre cropping in the Northern Territory

  https://crcna.com.au/research/projects/potential-broadacre-cropping-nt

Photo: Tony Matchett

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