Office Use Only	
Project Code	
Project Type	

FINAL REPORT 2020

Applicants must read the *SAGIT Project Funding Guidelines 2020* prior to completing this form. These guidelines can be downloaded from www.sagit.com.au

Final reports must be submitted by email to admin@sagit.com.au as a Microsoft Word document in the format shown **within two months** after the completion of the Project Term.

PROJECT CODE	LPB117
PROJECT TITLE (10 words maximum)	
DEVELOPMENT OF DUAL PURPOSE AWNLESS WHEAT VARIETIES FOR FROST MANAGEMENT	

PROJECT DURATION *These dates **must** be the same as those stated in the Funding Agreement.*			
Project start date	**1/06/2017**		
Project end date	**1/06/2020**		
SAGIT Funding Request	**2017/18**	**2018/19**	**2019/20**

PROJECT SUPERVISOR CONTACT DETAILS *(responsible for the overall project)*		
Title:	**First Name:**	**Surname:**
DR	Bertus	Jacobs
Organisation:	LongReach Plant Breeders Management Pty Ltd	
Mailing address:		
Telephone:		
Mobile:		

ADMINISTRATION CONTACT DETAILS *(responsible for all administrative matters relating to project)*		
Title:	**First Name:**	**Surname:**
Organisation:	LongReach Plant Breeders Management Pty Ltd	
Mailing address:		
Telephone:		
Mobile:		

PROJECT REPORT: *Please provide a clear description for each of the following:*

Executive Summary (200 words maximum)

A few paragraphs covering what was discovered, written in a manner that is easily understood and relevant to SA growers. A number of key dot points should be included which can be used in SAGIT communication programs.

- LPB117 project was initiated for germplasm development of dual purpose awnless wheat variety with a wide range of maturity specifically for frost management for SA growers.
- LongReach Plant Breeders had been approached by several growers and agronomists over the past few years for the development of an awnless dual purpose wheat variety to mitigate frost risks.
- The Double Haploid (DH) technique ensures that homozygosity of crosses is achieved in one generation in comparison to six generations via conventional breeding.
- From 2017 to 2020, LPB has developed 4400 double haploid lines from 18 crosses. Of these, 1404 are being tested in stage 1 breeding trials and 60 in stage 2 and 4 in stage 3 trials in 2020. LPB is continuing to progress the germplasm developed from LPB117 project for the next six years.

Project objectives

A concise statement of the aims of the project in outcome terms should be provided.

Double Haploid (DH) lines successfully produced over three years for the development of awnless wheat for dual purpose grain and hay production to manage frost risks in all wheat production areas of South Australia.

Overall Performance

A concise statement indicating the extent to which the project objectives were achieved, a list of personnel who participated in the Research Project including co-operators, and any difficulties encountered and the reasons for these difficulties.

- The LPB117 project has progressed relatively well despite two very poor/dry season finishes in 2018 and 2019. The very frosty conditions of September 2019 contributed to the total loss of stage 1 trials at Pinery. Breeding row germplasm were harvested for stage 1 trials in 2020.
- Stage 1 replicated trial at Birchip was used as seed source for 2020 stage 2 trials.
- The project was able to fulfill all its set KPI's per season regardless of, very high temperatures in the summer nursery **(Figure 1, 2)**.
- LPB117 project was led by Dr Bertus Jacobs, the LongReach Plant Breeders crop research lead.
- The seed preparation, field assessments and administrative project work was handled by Shafiya Hussein, who manages LongReach Plant Breeders pure seed production and PBR processes.
- LPB117 crosses were done at Cobbitty, NSW and University of Adelaide, SA. Double Haploid populations were developed by DAFWA, WA. Crossing parents and additional germplasm were sourced from CSIRO and AGG.
- Stage 1, stage 2 and stage 3 trials were packed by an automated seed packer in magazines by the operations team at Lonsdale.
- Drones were managed by Colin Edmondson and Sarah Naylor who are the product development manager and technical officer respectively.
- Summer and winter cycle trials were sown and managed by Kalyx and AgXtra.
- The summer nursery 2019 observation rows were damaged by three days of over 40^0C and sand blasting due to high winds. LPB117 incurred a 70% loss of germplasm for stage 1 trials, however, reserve seeds have been planted in pots by Andrew Matthews of Trans Grains, Virginia, SA. These revived lines will be available for summer nursery increases in 2020 and LPB trials in 2021 **(Figure 3).**
- Winter nursery 2019 was damaged by frost temperatures of -5^0 C at Pinery, SA. Severe frost impacted stems as well as ears at various growth stages (booting to half grain fill).

- Grain receival quality was done in the LPB lab at Lonsdale, SA. Flour quality and end product testing is done by VIDA at Horsham, Vic. Results will determine whether quality targets (APW/AH) were achieved.
- LPB breeder has a rigorous germplasm selection system based on yield, agronomy, disease resistance and cereal quality.

Figure 1: Footage of LPB summer nursery, Naracoorte, SA devastation due to 3 consecutive days of over 40^0 C and sand blasting. Awnless breeding row blocks M50, M51 and M53 were also impacted.

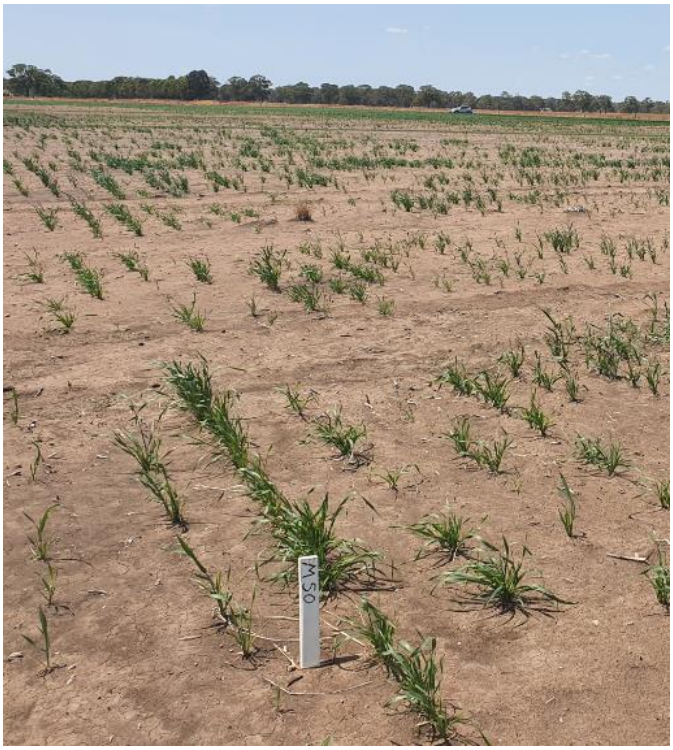


Figure 2 Germplasm lost in 2019 summer nursery.

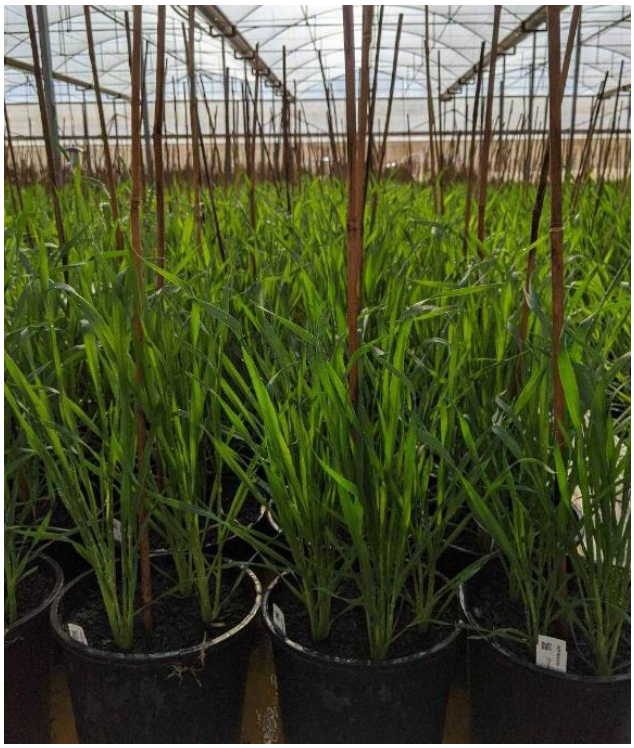


Figure 3: Reserve seed planted in pots at Virginia facility (June 2020).

KEY PERFORMANCE INDICATORS (KPI)

*Please indicate whether KPIs were achieved. The KPIs **must** be the same as those stated in the Application for Funding and a brief explanation provided as to how they were achieved or why they were not achieved.*

KPI	Achieved	If not achieved, please state reason.
• 2017/2018- Grow crossing blocks, cross lines, producing F1 • Source and assess currently available awnless material	Yes ☒ No ☐	
• Bulk cycle 1 DH lines up in summer nursery • 2018/2019 - Grow second crossing block, cross lines, produce F1 • Develop five DH (double haploid) populations, • Plant selected awnless germplasm in Stage 1 trials– Mid North (Freeling & Balaklava) •	Yes ☒ No ☐	
• Bulk cycle 2 DH lines up in summer nursery • 2019/2020 - Grow third crossing block, cross lines, • Develop five DH (double haploid) populations, • Plant selected awnless germplasm in Stage 1 trials– Mid North • Plant selected awnless germplasm in Stage 2 trials– Mid North, Mallee •	Yes ☒ No ☐	

TECHNICAL INFORMATION (Not to exceed **three** pages)

Provide sufficient data and short clear statements of outcomes.

- The following three pages detail the crosses, and the number of Double Haploid lines developed over three years.
- Some drone data was extracted to show the attributes assessed and images are provided to provide phenotypic comparison. The whole trial drone data has been provided as an attachment.
- Yield data is graphed for top 30 lines to descending yield trends 5-6.8t/ha. 2019 season preferred quick maturing varieties like Vixen, Scepter and Mace.
- Awnless material from LPB117 will be trialed at various times of sowing times to evaluate frost tolerance, grain and hay quality.

Table 1: LPB117 Crosses – COBBITTY 2017
CYCLE 1

Source Entry Book	Source ID	Where Placed	CRSNO	MATID	GENCD	QTARG	LRCC
PBIC Crossing 2017	2017WNGermplasm Development:PBIC Crossin	F1 SVIR 2017	LR17000167	17LR034655	F1	AH	LPB
PBIC Crossing 2017	2017WNGermplasm Development:PBIC Crossin	F1 SVIR 2017	LR17000168	17LR034656	F1	AH	LPB
PBIC Crossing 2017	2017WNGermplasm Development:PBIC Crossin	F1 SVIR 2017	LR17000169	17LR034657	F1	AH	LPB
PBIC Crossing 2017	2017WNGermplasm Development:PBIC Crossin	F1 SVIR 2017	LR17000170	17LR034658	F1	AH	LPB
PBIC Crossing 2017	2017WNGermplasm Development:PBIC Crossin	F1 SVIR 2017	LR17000171	17LR034659	F1	AH	LPB
PBIC Crossing 2017	2017WNGermplasm Development:PBIC Crossin		LR17000172	17LR034660	F1	AH	LPB
PBIC Crossing 2017	2017WNGermplasm Development:PBIC Crossin	DAFWA DH 2018	LR17000173	17LR034661	F1	AH	LPB
PBIC Crossing 2017	2017WNGermplasm Development:PBIC Crossin	F1 SVIR 2017	LR17000174	17LR034662	F1	AH	LPB
PBIC Crossing 2017	2017WNGermplasm Development:PBIC Crossin	DAFWA DH 2018	LR17000175	17LR034663	F1	AH	LPB
PBIC Crossing 2017	2017WNGermplasm Development:PBIC Crossin	F1 SVIR 2017	LR17000176	17LR034664	F1	AH	LPB
PBIC Crossing 2017	2017WNGermplasm Development:PBIC Crossin	DAFWA DH 2018	LR17000177	17LR034665	F1	AH	LPB
PBIC Crossing 2017	2017WNGermplasm Development:PBIC Crossin	F1 SVIR 2017	LR17000178	17LR034666	F1	AH	LPB
PBIC Crossing 2017	2017WNGermplasm Development:PBIC Crossin	F1 SVIR 2017	LR17000179	17LR034667	F1	APW	LPB
PBIC Crossing 2017	2017WNGermplasm Development:PBIC Crossin	DAFWA DH 2018	LR17000180	17LR034668	F1	APW	LPB
PBIC Crossing 2017	2017WNGermplasm Development:PBIC Crossin	F1 SVIR 2017	LR17000181	17LR034669	F1	APW	LPB
PBIC Crossing 2017	2017WNGermplasm Development:PBIC Crossin	DAFWA DH 2018	LR17000182	17LR034670	F1	APW	LPB
PBIC Crossing 2017	2017WNGermplasm Development:PBIC Crossin	F1 SVIR 2017	LR17000183	17LR034671	F1	APW	LPB
PBIC Crossing 2017	2017WNGermplasm Development:PBIC Crossin	DAFWA DH 2018	LR17000184	17LR034672	F1	APW	LPB
PBIC Crossing 2017	2017WNGermplasm Development:PBIC Crossin	F1 SVIR 2017	LR17000185	17LR034673	F1	AH	LPB
PBIC Crossing 2017	2017WNGermplasm Development:PBIC Crossin	F1 SVIR 2017	LR17000186	17LR034674	F1	AH	LPB
PBIC Crossing 2017	2017WNGermplasm Development:PBIC Crossin	F1 SVIR 2017	LR17000187	17LR034675	F1	AH	LPB
PBIC Crossing 2017	2017WNGermplasm Development:PBIC Crossin	F1 SVIR 2017	LR17000188	17LR034676	F1	AH	LPB
PBIC Crossing 2017	2017WNGermplasm Development:PBIC Crossin	F1 SVIR 2017	LR17000189	17LR034677	F1	AH	LPB
PBIC Crossing 2017	2017WNGermplasm Development:PBIC Crossin	F1 SVIR 2017	LR17000190	17LR034678	F1	AH	LPB

Table 2: LPB117 DH- DAFWA 2018

Source Entry Book	Source ID	Where Placed	CRSNO	MATID	GENCD	QTARG	LRCC
PBIC Crossing 2017	2017WNGermplasm Development:PBIC Crossin	DAFWA DH 2018	LR17000173	17LR034661	F1	AH	LPB
PBIC Crossing 2017	2017WNGermplasm Development:PBIC Crossin	DAFWA DH 2018	LR17000175	17LR034663	F1	AH	LPB
PBIC Crossing 2017	2017WNGermplasm Development:PBIC Crossin	DAFWA DH 2018	LR17000177	17LR034665	F1	AH	LPB
PBIC Crossing 2017	2017WNGermplasm Development:PBIC Crossin	DAFWA DH 2018	LR17000180	17LR034668	F1	APW	LPB
PBIC Crossing 2017	2017WNGermplasm Development:PBIC Crossin	DAFWA DH 2018	LR17000182	17LR034670	F1	APW	LPB
PBIC Crossing 2017	2017WNGermplasm Development:PBIC Crossin	DAFWA DH 2018	LR17000184	17LR034672	F1	APW	LPB

Table 3: LPB117 Crosses – COBBITTY 2018
CYCLE 2

Source Entry Book	Source ID	Where Placed	CRSNO	MATID	GENCD	QTARG	LRCC
PBIC Crossing 2018	2018WNGermplasm Development:PBIC Crossin	DH DAFWA 2019	LR18000147	18LR007723	F1	APW	LPB/CSIRO
PBIC Crossing 2018	2018WNGermplasm Development:PBIC Crossin	DH DAFWA 2019	LR18000148	18LR007724	F1	APW	LPB
PBIC Crossing 2018	2018WNGermplasm Development:PBIC Crossin	DH PBIC 2019	LR18000149	18LR007725	F1	APW	LPB/CSIRO
PBIC Crossing 2018	2018WNGermplasm Development:PBIC Crossin	DH PBIC 2019	LR18000150	18LR007726	F1	APW	LPB/AP
PBIC Crossing 2018	2018WNGermplasm Development:PBIC Crossin	F1 Pots 2018	LR18000151	18LR007727	F1	APW	LPB
PBIC Crossing 2018	2018WNGermplasm Development:PBIC Crossin	F1 Pots 2018	LR18000152	18LR007728	F1	APW	LPB
PBIC Crossing 2018	2018WNGermplasm Development:PBIC Crossin	DH PBIC 2019	LR18000153	18LR007729	F1	AH	LPB/CSIRO
PBIC Crossing 2018	2018WNGermplasm Development:PBIC Crossin	DH PBIC 2019	LR18000154	18LR007730	F1	AH	LPB
PBIC Crossing 2018	2018WNGermplasm Development:PBIC Crossin	DH PBIC 2019	LR18000155	18LR007731	F1	AH	LPB/CSIRO
PBIC Crossing 2018	2018WNGermplasm Development:PBIC Crossin	DH PBIC 2019	LR18000156	18LR007732	F1	AH	LPB/AP
PBIC Crossing 2018	2018WNGermplasm Development:PBIC Crossin	F1 Pots 2018	LR18000157	18LR007733	F1	AH	LPB
PBIC Crossing 2018	2018WNGermplasm Development:PBIC Crossin	F1 Pots 2018	LR18000158	18LR007734	F1	AH	LPB
PBIC Crossing 2018	2018WNGermplasm Development:PBIC Crossin	F1 Pots 2018	LR18000159	18LR007735	F1	APW	LPB/CSIRO
PBIC Crossing 2018	2018WNGermplasm Development:PBIC Crossin	F1 Pots 2018	LR18000160	18LR007736	F1	APW	LPB/CSIRO
PBIC Crossing 2018	2018WNGermplasm Development:PBIC Crossin	F1 Pots 2018	LR18000161	18LR007737	F1	APW	AP/CSIRO
PBIC Crossing 2018	2018WNGermplasm Development:PBIC Crossin	F1 Pots 2018	LR18000162	18LR007738	F1	APW	LPB/AP
PBIC Crossing 2018	2018WNGermplasm Development:PBIC Crossin	F1 Pots 2018	LR18000163	18LR007739	F1	AH	LPB

Table 4: LPB117 DH- DAFWA 2019

Source Entry Book	Source ID	Where Placed	CRSNO	MATID	GENCD	QTARG	LRCC
PBIC Crossing 2018	2018WNGermplasm Development:PBIC Crossin	DH DAFWA 2019	LR18000147	18LR007723	F1	APW	LPB/CSIRO
PBIC Crossing 2018	2018WNGermplasm Development:PBIC Crossin	DH DAFWA 2019	LR18000148	18LR007724	F1	APW	LPB
PBIC Crossing 2018	2018WNGermplasm Development:PBIC Crossin	DH PBIC 2019	LR18000149	18LR007725	F1	APW	LPB/CSIRO
PBIC Crossing 2018	2018WNGermplasm Development:PBIC Crossin	DH PBIC 2019	LR18000150	18LR007726	F1	APW	LPB/AP
PBIC Crossing 2018	2018WNGermplasm Development:PBIC Crossin	DH PBIC 2019	LR18000153	18LR007729	F1	AH	LPB/CSIRO
PBIC Crossing 2018	2018WNGermplasm Development:PBIC Crossin	DH PBIC 2019	LR18000154	18LR007730	F1	AH	LPB
PBIC Crossing 2018	2018WNGermplasm Development:PBIC Crossin	DH PBIC 2019	LR18000155	18LR007731	F1	AH	LPB/CSIRO
PBIC Crossing 2018	2018WNGermplasm Development:PBIC Crossin	DH PBIC 2019	LR18000156	18LR007732	F1	AH	LPB/AP

Table 6: LPB117 Crosses – UNIVERSITY OF ADELAIDE 2019 CYCLE 3

Source Entry Book	Source ID	CRSNO	MATID	GENCD	QTARG	LRCC
PBIC Crossing 2019	19WGermplasm Development:PBIC Crossing:0	LR19000144	19LR000770	F1	AH	LPB
PBIC Crossing 2019	19WGermplasm Development:PBIC Crossing:0	LR19000145	19LR000771	F1	AH	LPB
PBIC Crossing 2019	19WGermplasm Development:PBIC Crossing:0	LR19000146	19LR000772	F1	APW	LPB/CSIRO
PBIC Crossing 2019	19WGermplasm Development:PBIC Crossing:0	LR19000147	19LR000773	F1	APW	LPB/CSIRO
PBIC Crossing 2019	19WGermplasm Development:PBIC Crossing:0	LR19000148	19LR000774	F1	APW	LPB/CSIRO
PBIC Crossing 2019	19WGermplasm Development:PBIC Crossing:0	LR19000149	19LR000775	F1	AH	LPB
PBIC Crossing 2019	19WGermplasm Development:PBIC Crossing:0	LR19000150	19LR000776	F1	AH	LPB
PBIC Crossing 2019	19WGermplasm Development:PBIC Crossing:0	LR19000151	19LR000777	F1	AH	LPB/CSIRO
PBIC Crossing 2019	19WGermplasm Development:PBIC Crossing:0	LR19000152	19LR000778	F1	AH	LPB/CSIRO
PBIC Crossing 2019	19WGermplasm Development:PBIC Crossing:0	LR19000153	19LR000779	F1	AH	LPB/CSIRO
PBIC Crossing 2019	19WGermplasm Development:PBIC Crossing:0	LR19000154	19LR000780	F1	APW	LPB
PBIC Crossing 2019	19WGermplasm Development:PBIC Crossing:0	LR19000155	19LR000781	F1	APW	LPB/CSIRO
PBIC Crossing 2019	19WGermplasm Development:PBIC Crossing:0	LR19000156	19LR000782	F1	APW	LPB/CSIRO
PBIC Crossing 2019	19WGermplasm Development:PBIC Crossing:0	LR19000157	19LR000783	F1	APW	LPB/CSIRO
PBIC Crossing 2019	19WGermplasm Development:PBIC Crossing:0	LR19000158	19LR000784	F1	APW	LPB
PBIC Crossing 2019	19WGermplasm Development:PBIC Crossing:0	LR19000159	19LR000785	F1	APW	LPB/CSIRO
PBIC Crossing 2019	19WGermplasm Development:PBIC Crossing:0	LR19000160	19LR000786	F1	APW	LPB/CSIRO
PBIC Crossing 2019	19WGermplasm Development:PBIC Crossing:0	LR19000161	19LR000787	F1	APW	LPB/CSIRO
AU Crossing 2019	19WGermplasm Development:PBIC Crossing:0	LR19000162	19LR000788	F1	APW	LPB/CSIRO
AU Crossing 2019	19WGermplasm Development:PBIC Crossing:0	LR19000163	19LR000789	F1	APW	LPB/CSIRO
AU Crossing 2019	19WGermplasm Development:PBIC Crossing:0	LR19000164	19LR000790	F1	APW	LPB/CSIRO
AU Crossing 2019	19WGermplasm Development:PBIC Crossing:0	LR19000165	19LR000791	F1	APW	LPB/CSIRO
AU Crossing 2019	19WGermplasm Development:PBIC Crossing:0	LR19000166	19LR000792	F1	APW	LPB/CSIRO
AU Crossing 2019	19WGermplasm Development:PBIC Crossing:0	LR19000167	19LR000793	F1	APW	LPB/CSIRO
AU Crossing 2019	19WGermplasm Development:PBIC Crossing:0	LR19000168	19LR000794	F1	APW	LPB/CSIRO
AU Crossing 2019	19WGermplasm Development:PBIC Crossing:0	LR19000169	19LR000795	F1	APW	LPB/CSIRO
AU Crossing 2019	19WGermplasm Development:PBIC Crossing:0	LR19000170	19LR000796	F1	APW	LPB/CSIRO
AU Crossing 2019	19WGermplasm Development:PBIC Crossing:0	LR19000171	19LR000797	F1	APW	LPB/CSIRO
AU Crossing 2019	19WGermplasm Development:PBIC Crossing:0	LR19000172	19LR000798	F1	APW	LPB/CSIRO
AU Crossing 2019	19WGermplasm Development:PBIC Crossing:0	LR19000173	19LR000799	F1	APW	LPB/CSIRO

Table 5: LPB117 DH- DAFWA 2020

Source Entry Book	Source ID	Where Placed	CRSNO	MATID	GENCD	QTARG	LRCC	REMARK
PBIC Crossing 2019	19WGermplasm Development:PBIC Crossing:0	DH DPIRD 2020	LR19000144	19LR000770	F1	AH	LPB	ship4
AU Crossing 2019	19WGermplasm Development:PBIC Crossing:0	DH DPIRD 2020	LR19000166	19LR000792	F1	APW	LPB/CSIRO	ship4
PBIC Crossing 2019	19WGermplasm Development:PBIC Crossing:0	DH PBIC 2020	LR19000149	19LR000775	F1	AH	LPB	PBIC33
AU Crossing 2019	19WGermplasm Development:PBIC Crossing:0	DH PBIC 2020	LR19000162	19LR000788	F1	APW	LPB/CSIRO	PBIC34
AU Crossing 2019	19WGermplasm Development:PBIC Crossing:0	DH PBIC 2020	LR19000163	19LR000789	F1	APW	LPB/CSIRO	PBIC35

DRONE DATA 2019

DJI Phantom 4 Pro drones flown at each trial throughout the season with an RGB camera at an altitude of 20m **(Figure 4)**

Figure 4: Phantom 4 Pro with MicaSense Red Edge Camera Integrated

Note that no drone data is available for Pinery as the region is considered a 'no flight' zone to the proximity of restricted airspace as stated in the Civil Aviation Safety Authority (CASA). For 2019 trials, Birchip site data is available for all 960 plots **(Figure 5)**.

Raw data was sent to HIPHEN, a company who specialize in high end plant phenotyping systems who process the data at the microplot level, with values for following traits:

- **Fcover (green fraction)** – fraction of the ground covered by green vegetation **(Figure 6)**
- **RSD (Relative Standard Deviation)** – an indicative value for plot quality
- **Vegetation Indices**
  VARI - (Green-Red)/Green + Red - Blue) an indication of leaf area index
  Excess green – (2*Green - Red – Blue) an indication of how "green" the canopy is
  G/R – (Green/Red) an indication of how "green" the canopy is **(Figure 7)**
- **Height**
  Height (cm) – Maximum height of the plot
  Mean Height (cm) – Average height across a plot **(Figure 8)**

We are currently looking into Multispectral Imagery which can detect and diagnose plant stress much earlier, and provides additional Vegetation Indices which gives an insight into plant biomass.

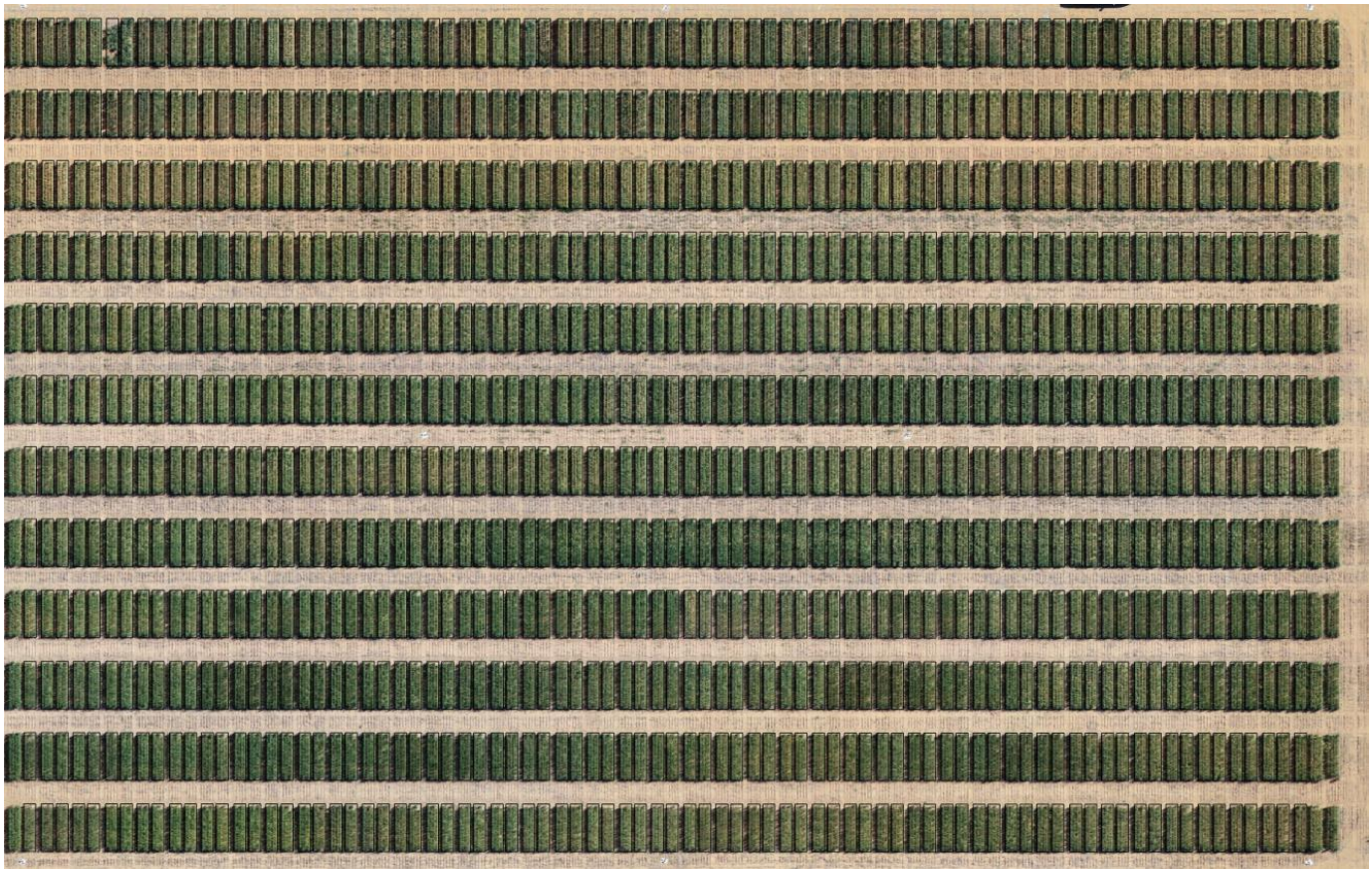


Figure 5: LPB117 Awnless stage 1 trial footage at Birchip, Vic on 15th October, 2019

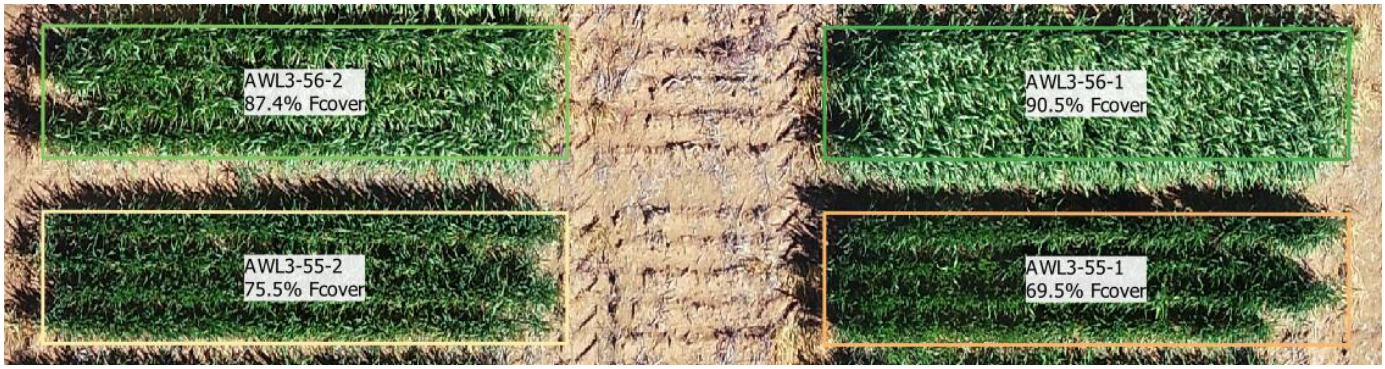


Figure 6: Canopy Cover; categorized plot boundaries by Fcover showing erect leaves vs longer, bent over leaves. Flight taken 30 August, 2019

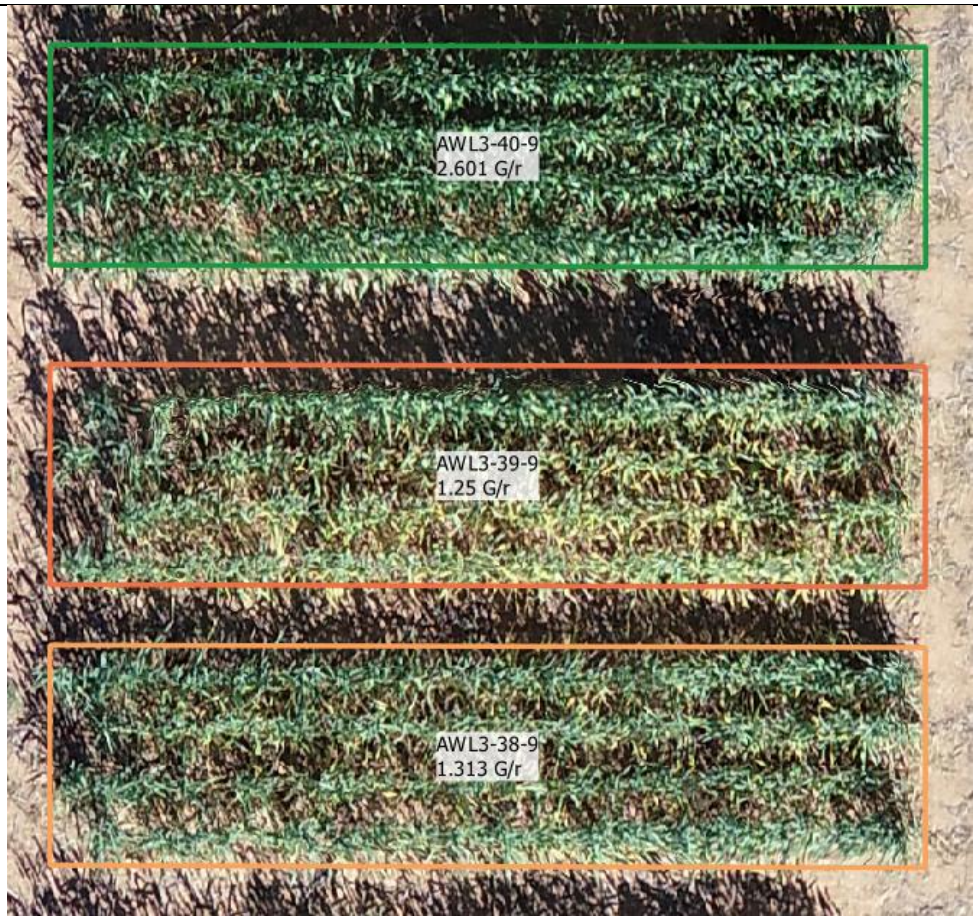
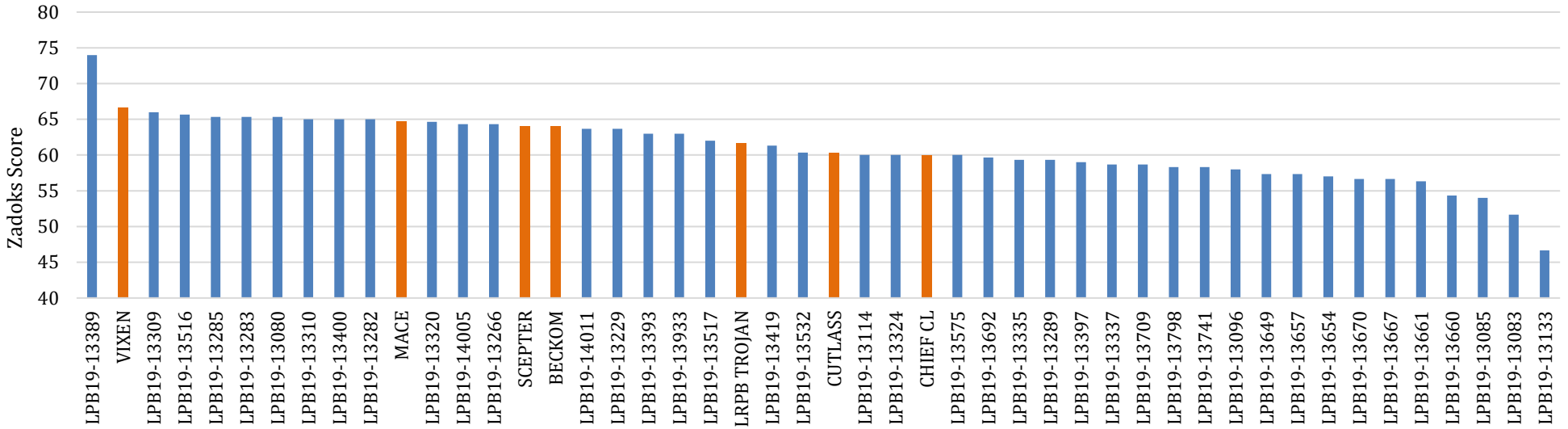


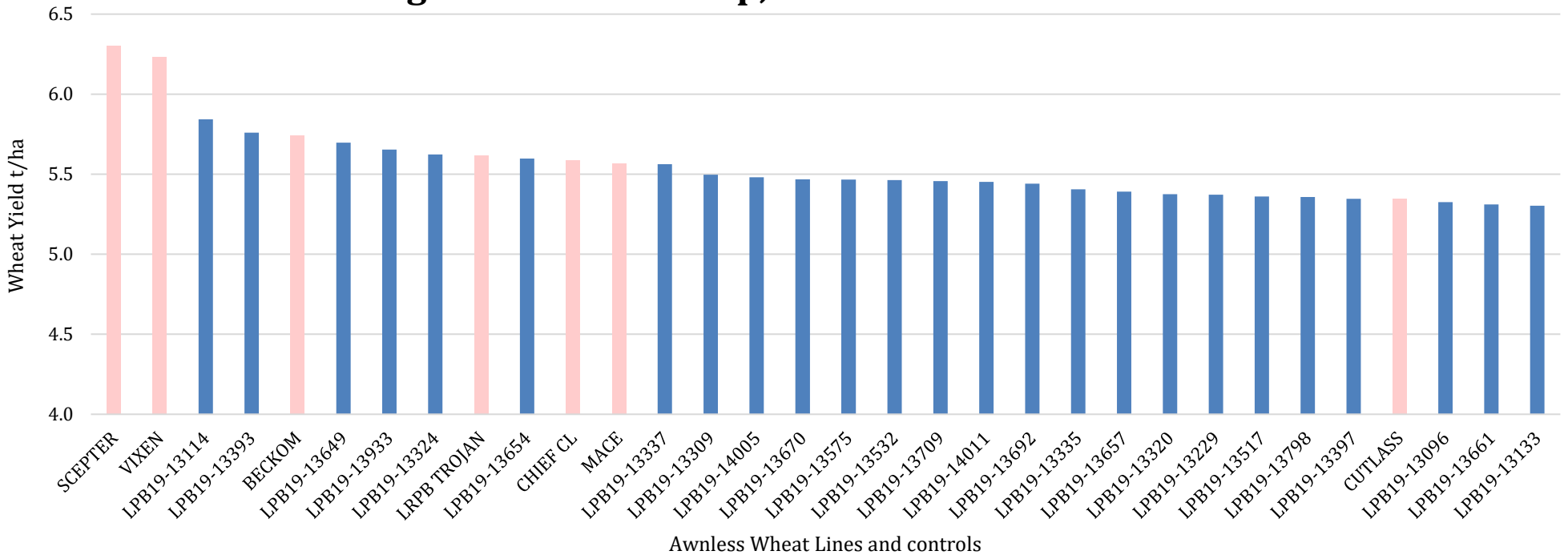
Figure 7: Vegetation Index; categorized Plot boundaries by Vegetation Index – in this case Green/Red. This flight was taken on the 15th of October, 2019 as the plots began to Senesce.

Figure 8: Heights of plots compared with Orion; VBIR, 2019

Wheat maturity ranges in 2020 selections



Awnless Stage 1 Yield at Birchip, VIC 2019



LPB117 Concise statement of awnless wheat germplasm outcomes 2017-2020

YEAR	EVENT	SITE	NUMBERS	Month	COMMENTS
2017	Crossing Block 1	SBAL	24	Jan-Sept	Crossings - Cobbitty
	Awnless Germplasm	SBAL	500	Apr-Dec	AGG + CSIRO + GXE (identify parents)
2018	Crossing Block 2	SBAL	17	Jan-Sept	Crossings - Cobbitty
	DH Development 1	WA	5	Dec-Nov	1st DH Population - DAFWA
	Stage 1	SBAL, SFRE	169	Apr-Dec	AGG + CSIRO + GXE -Parents & selections
	Summer Nursery Bulk up 1	SNAR	948	Dec-Apr	1st DH Population of 2017
2019	Crossing Block 3	SBAL	13	Jan-Sept	Crossings - UoA
	DH Development 2	WA	8	Dec-Nov	2nd DH Population - DAFWA
	Stage 1	VBIR	990	Apr-Dec	from Crossing Block 1 + DH Develo
	Stage 2	SFRE, VBIR	10	Apr-Dec	AGG + CSIRO + GXE - Selections
	Summer Nursery Bulk up 2	SNAR	1154	Dec-Apr	2nd DH Population of 2018
2020	DH Development 3	WA	5	Dec-Nov	3rd DH Population
	Stage 1	SBAL	432	Apr-Dec	Heat wave impacted SN bulk up Dec
	Stage 2	SBAL, SFRE	55	Apr-Dec	
	Stage 3	EM3'S	4	Apr-Dec	AGG + CSIRO + GXE - Selections
	Summer Nursery Bulk up 3	SBAL	+ 1000	Dec-Apr	3rd DH Population of 2019

CONCLUSIONS REACHED &/OR DISCOVERIES MADE (Not to exceed one page)

Please provide concise statement of any conclusions reached &/or discoveries made.

- LPB117 project has successfully developed awnless wheat germplasm with a range, growth habits, maturity and yield over three years of crossing and double haploid population development.
- LPB117 germplasm development and testing will continue for the next six years despite the project completion in June 2020.
- SAGIT will continue to receive progress reports of the outcome of double haploid awnless germplasm development as it continues in the LongReach PB breeding program.
- LPB117 germplasm are in breeding rows, stage 1, stage 2 and stage 3 trials of 2020 and the cycle will continue in 2021 and so forth.
- Awnless germplasm will be evaluated in frost prone areas of South Australia for evaluation in 2020, 2021 and 2022.

INTELLECTUAL PROPERTY

Please provide concise statement of any intellectual property generated and potential for commercialisation.

- Prior to LPB117 project variety release; a commercial license agreement will be established between LPB and ADVANTA.
- A variety line profile will be prepared and Breeder royalty set. The variety will be provided a suitable name by the marketing team and added to Wheat Quality Australia master list.
- The variety name will be processed via IP Australia for Plant Breeder Rights Part 1&2.
- LPB117 project variety release is scheduled for 2024/2025 season after the quality classification has been completed (six data sets over a three-year period).

APPLICATION / COMMUNICATION OF RESULTS

A concise statement describing activities undertaken to communicate the results of the project to the grains industry. This should include:

- *Main findings of the project in a dot point form suitable for use in communications to farmers;*
- *A statement of potential industry impact*
- *Publications and extension articles delivered as part of the project; and,*
- *Suggested path to market for the results including barriers to adoption.*

Note that SAGIT may directly extend information from Final reports to growers. If applicable, attach a list of published material.

- LongReach Plant Breeders in collaboration with SAGIT has developed dual purpose awnless germplasm to be trialed for the next six seasons.
- Current and future trials will target yield, grain and hay quality and frost tolerance.
- Awnless wheat is suitability for hay cuts should a region experience heavy frost post ear emergence. Targeted development of wheat 'without awns' ensure grazing by livestock without the risk of damage to its sensitive oral linings.
- Publications in 'Research Gate' calculate broadacre losses due to frost at between $120-700 million a year for Australian farmers (Crimp SJ *et al*, Crop & Pasture Science, 2016, **67**, 801-811)
- Frost has become a serious concern for farmers over the past five years with SA growers losing some $200 million in 2016, 2017, 2018 and 2019.
- An AH/APW awnless dual purpose hay and grain wheat variety would be ideally suited not only to frost prone areas, but a wider wheat belt. Under extreme frost conditions, wheat is cut for hay either pre or post ear emergence. If frost is avoided,

then grain is sold. Either way, the grower is able to manage severe financial loss by sale of hay or grain and straw.

PUBLICATIONS & SOCIAL MEDIA 2017-2020

Frost on the run from awnless wheat varieties

December 15, 2017

Development of double-haploid breeding populations to fast track production of dual-purpose awnless wheat for frost-prone areas of South Australia has the potential to drastically cut losses – estimated to cost growers about $33 million a year – and give them more profitable options for grain and hay production.

Following widespread damage across Australia in 2017, from Queensland to Western Australia, southern New South Wales and South Australia, Adelaide-based LongReach Plant Breeders Management Pty Ltd committed to a three-year SAGIT-funded project, *Development of dual-purpose wheat varieties for frost management,* with the aim of commercializing specific varieties for the state's high and low rainfall areas.
"This is a timely project that will give growers the chance to mitigate damage on-farm, especially in high-risk areas such as the Mallee, Mid North and Eyre Peninsula," said Dr Bertus Jacobs, project supervisor and LongReach crop research leader.

"While it's not possible to predict all events, by looking at temperatures it is possible to narrow the frost window down to about four weeks.

"With 2017 frost costing Australian growers about $100m, the research becomes more and more important," he said.

LongReach research assistant and pure seed manager Shafiya Hussein says the use of awnless wheat varieties increases the opportunities to cut a cereal crop for hay.

"Growing hay in high-risk paddocks has become an effective frost avoidance strategy," she said.

"Previously, there has been no targeted breeding of dual-purpose awnless wheat varieties specifically for SA, with either long season spring or winter types developed for other areas of the Australian wheat belt being used.

"The target quality grade for SA growers is APW/AH, so the current varieties' grain quality, soft or feed, limit the profitability of awnless wheat for grain production."

Hay production also had the additional benefit of improving overall weed control through weed suppression in crop and cutting before the growth of weed seeds.

Dr Jacobs said the initial stage of establishing a double haploid population involved completing a crossing block of 450 lines of Australian awnless varieties to assess suitable parents. These would be evaluated next year in tandem with development of another 1000 lines, from which several could be cited as possible commercial varieties.

"There are several mechanisms involved, with the project aiming to enable growers' flexibility in seeding times and crop maturity, with the ability to cut for grain or hay" he said.

"In 2019, we will proceed to more extensive field trials and assess components such as straw strength, colour and grain quality."

Although wheaten hay and straw is not marketed as extensively as oaten hay, there is increasing demand domestically and in Japan, Korea, New Zealand, Taiwan, Saudi Arabia and Brunei.

Ms Hussein said hay exporters JT Johnson & Sons, Balco Australia and Kalleske Chaff in SA supported the need for awnless hay wheat varieties to meet the growing demand and industry support was being offered for hay and chaff quality testing as part of the project's variety development.

POSSIBLE FUTURE WORK

Provide possible future directions for the research arising from the project including potential for further work and partnerships.

- Awnless germplasm from LPB117 project (2017-2020) has extended into another collaborative venture with SAGIT.
- LPB120 project (2020-2023) evaluates dual purpose awnless wheat varieties for frost management at three frost prone sites in South Australia; Marrabel, Jamestown and Geranium.
- The evaluation include time of sowing trails at 3 locations and 3 sowing (22nd April, 18th May and 8th June).
- LongReach Plant Breeders are evaluating stage 1 and stage 2 awnless germplasm developed from LPB117 at Pinery, Tarlee, Paskeville, Birchip and Murrayville.
- Potential commercial variety released from this partnership will include a breeder royalty share for SAGIT and LPB as agreed upon by the SAGIT and LPB board.
- LongReach Plant Breeders envisages future collaborative work with SAGIT on selective breeding and agronomy issues facing South Australian cereal farmers.

SAGIT would be crucial in bringing challenging growers' issues to LPB for specific product development that will sustain South Australian agricultural economy.