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Project Code	
Project Type	

FINAL REPORT 2019

PROJECT CODE :	**S1117**

PROJECT TITLE :	**CARASA: Cereal Aphid Risk Assessment for SA**

PROJECT DURATION

Project Start date	10 April 2017					
Project End date	30 June 2019					
SAGIT Funding Request	2016/2017		2017/2018		2018/2019	

PROJECT SUPERVISOR CONTACT DETAILS

The project supervisor is the person responsible for the overall project

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PROJECT REPORT

Executive Summary

The effect of sowing dates of cereals on the risk of aphid infestation was tested during two years in three locations in South Australia. In 2018 the level of naturally occurring Russian wheat aphid (RWA) infestations was low in all chosen trial locations (Bool Lagoon, Loxton, Turretfield), with only June and July sowing in the Loxton Area experiencing significant RWA numbers. In 2019 (Keith, Loxton, Riverton) aphid infestations were extremely low in all sites and sowing dates. Corn and oat aphids were observed only in Bool Lagoon (2018) and Keith (2019).

Yellow pan trap and suction trap samplings showed RWA migration mainly in the months of September to December, with minor migration events in March to May dependent on a persisting green bridge.

RWA migration occurred only during warm days (>25°C). Crops that were beyond GS40 during RWA migration periods did not get infested during aphid migrations.

These results, combined with agronomists' reports and observations, show that risk for RWA infestation occurs for crops less thanGS40 that are present during RWA migration periods. So this is either very early sowing (March/early April) via RWA from green bridge situations or very late (July/August) sown crops via early spring migrations from crops and/or winter grasses.

Project Objectives

In this project we aimed to provide an accurate estimation of the threat that cereal aphids (all species) pose, in relation to sowing date, crop type and farmers' management practices (including seed treatment) in the three main agro-ecological zones of South Australia (low rainfall (Mallee), medium rainfall (Mid-North) and high rainfall (South-East)).

Results of the aphid and symptom observations were reported 'live' to farmers and agronomists through electronic media, such as the PIRSA website and Cesar 'RWA Portal', making information accessible to all and allowing optimization of agronomists' advice and growers' decisions on cereal aphid management in the current season.

Overall Performance

The project performed reasonably well, but cereal aphid pressure was low during 2017 and very low during 2018 due to dry summer conditions reducing green bridge grasses and volunteer cereals.

This made it impossible to show any significant yield effects from aphid infestation.

Key Performance Indicators (KPI)

KPI	*Achieved (Y/N)*	*If not achieved, please state reason.*
2017 - Selection and installation of sites finalized	Y	
2017 - Internet reporting site active	Y	In 2018 results were presented through the 'RWA portal' (http://cesaraustralia.com/sustainable-agriculture/rwa-portal/) as part of the GRDC project
2017 - Field Walk for Agronomists and Framers on each site	Y	See intermediate report
2017 - Fortnightly observation of sites for aphids and symptoms (May to September), then monthly till harvest finished	Y	See intermediate report
2018 - First observation round completed, interim report 1 submitted to SAGIT	Y	See intermediate report
2018 - 5 extension events done on first year	Y	See intermediate report
2018 - Field walk for Agronomists and Framers on each site	Y	Due to overall lack of aphids there was not much interest in these trials from farmers / agronomists. In Keith and Minnipa we presented the trial during a field day. McKillop Farming systems (20/09/18). Minnipa Agricultural Centre (20/09/18 through K. Perry),
2018 - Fortnightly observation of sites for aphids and symptoms (May to September), then monthly till harvest finished	Y	

2019 - Second Observation round completed, Interim report 2 submitted to SAGIT	Y	
2019 - Trapping results complete and analyzed	Y	
2019 - 5 extension events done	Y	Presentations in SA were done for McKillop Farming systems (20/09/18). Minnipa Agricultural Centre (20/09/18 through K. Perry), SABAC 28/08/2018 and 14/03/2019. A webinar on RWA research was held on 04/04/2019. Other presentations (outside SA) were linked to RWA GRDC project activities (Tasmania, Birchip, Toowoomba, Tamworth, Griffith)
2019 - Final report submitted to SAGIT	Y	

Technical Information

In this project we tested the effect of time of sowing on cereal aphid infestations in the 2017 and 2018 season.

In 2017 we tested 4 sowing dates (April, May, June, July), 3 cereal commodities (wheat, barley, durum wheat) and 3 treatments (untreated control, Imidacloprid seed treatment, Chlorpyrifos applied at GS35/40) in 3 locations (Bool Lagoon, Turretfield, Loxton). Results were reported in the 2018 progress report. Significant aphid infestations occurred only in the Loxton trial for the June and July sowings (all commodities and treatments). Please refer to the intermediate report for more details.

In 2018 we performed similar trials in Keith, Loxton and Riverton comparing 3 sowing dates (mid-April, early May, end of May), 3 treatments (same as 2017) and 3 cereal commodities (same as 2017).

In 2018 the second sowing date of these trials was combined with a GRDC project, and RWA inoculation of part of the plots was done to generate higher infestation levels and yield loss.

Results of the 2018 trials are (see attachment for details):

1. Aphid populations (all species) were very low for all sowing dates.
2. Neither TOS1 nor TOS3 showed significant RWA populations at any time in the season.
3. TOS2 Due to some spillover from the inoculated plots more RWA were observed in the TOS2 following the actual inoculations. These populations then persisted throughout the trial. Since no RWA or symptoms were observed in TOS2 in any sites prior to inoculations we consider that 'natural' RWA was insignificant and the observed RWA populations were only due to the inoculation spillover.
4. These spillover RWA contaminations in the TOS2 plots remained far below intervention thresholds (maximum < 2 aphids/100 tillers and < 2% of tillers with symptoms).
5. Other aphids: Only in Keith did we observe some oat aphids (late in the season) but again far below intervention thresholds.

6. No significant yield difference was observed for any treatment for any of the commodities, sites and sowing dates.
7. However, site, sowing date and commodities showed significant differences (and interactions) as expected because of differences in pedo-climatic conditions and the relative suitability of these conditions for different commodities.

In all sites we observed significant RWA populations around the actual trial site later in the season (October/November), especially on weedy grasses (barley grass, brome grasses) and on young re-growth (mown areas around trials), and also in the yellow pan traps set up in the same area but at least 100 meters away from each trial.

This confirms that RWA were present in each area during the season and migrating during spring. We hypothesize that these were probably originating from non-crop grasses since no other cereal crops with significant RWA populations were observed near the trial sites. When grasses mature and become less suitable hosts for RWA during ripening, wing induction occurs. Aphid migration then still requires high enough temperatures (+/- 25°C) to allow flight.

This observation however does confirm our 2017 observation that spring migration events of RWA occurred in all sites, but migrating aphids did not colonize more advanced cereal crops (> GS40).

Conclusions Reached &/or Discoveries Made

This project provided the following main results:

1. Risk of RWA infestation occurs with crops that are <GS40 during RWA migration periods.
2. Two migratory periods for RWA exist:
    a. Spring (September-December) is the main RWA migratory period when RWA populations (probably from grasses) are highest and flight conditions are favorable
    b. Early autumn (March-April) migration occurs only following favourable green bridge conditions and high enough temperatures for migration
3. Therefore risk of RWA infestation occurs (1) for very early sown (March/early April) crops via RWA from green bridge situations or (2) very late (July / August) sown crops via early spring migrations from crops and/or grasses.
4. Dry summers, which reduce the biomass of green bridge grasses, reduce regional pressure of cereal aphids (all species).
5. Risk of significant RWA infestation in autumn was low in both years of this study, and did not cause yield loss in the study plots.
6. Based on 2017 trials and reports: Risk of RWA infestation and yield loss in very late sowing seems significant if crops are still at early growth stages when spring migration occurs.
7. Oat and corn aphids are more prevalent in the southern, higher rainfall areas, probably depending on the higher availability of grasses over summer.
8. The aphid inoculated plots (GRDC Project) showed that:
    a. RWA development (aphid population density and percentage of tillers with symptoms) was higher in low rainfall areas of SA.
    b. High infestation levels were achieved but yield loss was still not statistically significant for most sites/commodities.
    c. Seed treatment (Imidacloprid) can avoid early infestation for (estimated) 4 to 5 weeks.
    d. Chlorpyrifos treatment at GS35-40 does remove most (but not all) RWA but eliminates the risk of yield loss.

Intellectual Property

N/A

Application / Communication of Results

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1. Russian wheat aphid (RWA) infestation risk in winter grown cereals is dependent on green bridge conditions and RWA migration.
2. Early sowing can cause higher risks of RWA infestation if:
   a. Summer rainfall has been sufficient for green bridge survival
   b. Temperatures after germination are high enough to allow aphid migration
3. Very late sowing which results in physiologically young crops (GS40) in August/September is a major risk because significant RWA migration events can occur during warm spring days.
4. Neonicotinoid seed treatments can be effective against early RWA infestations. However in the two years of this study at all three research sites and in other observed crops the RWA populations were well below intervention thresholds, and prophylactic seed treatments were not required.

POSSIBLE FUTURE WORK

This projects has highlighted that in the two years of this project cereal aphid populations were not requiring pesticide applications in SA.

This situation might be different if summer survival (green bridge) is higher in wet summers and more favorable conditions for aphid migration.

A new GRDC project (2018-2020) is continuing this research, aiming at establishing records of regional RWA pressure and the role of different grasses in summer survival. In this project aphid inoculation is used to obtain better information on RWA population development and intervention thresholds in different pedo-climatic conditions.

Attachment 1: Aphid populations per site, TOS and treatment

Table 1: RWA, % Tillers with Symptoms and Oat and Corn Aphid

		RWA / 100 Tillers			% Tillers with Symptoms			Average of Oat Aphid			Average of Corn Aphid		
SITE	TOS	1	2	3	1	2	3	1	2	3	1	2	3
	TREATMENT												
KEITH	Chlorpyrifos	0.00	0.58	0.00	0.02	1.61	0.00	0.04	0.06	0.07	0.00	0.00	0.00
	Gaucho	0.00	0.05	0.00	0.02	0.24	0.02	0.16	0.00	0.10	0.00	0.00	0.00
	Untreated Control	0.03	1.76	0.00	0.16	1.12	0.00	0.18	0.08	0.22	0.00	0.00	0.00
LOXTON	Chlorpyrifos	0.00	0.04	0.00	0.00	0.37	0.02	0.00	0.00	0.00	0.00	0.00	0.00
	Gaucho	0.00	0.00	0.00	0.00	0.14	0.12	0.00	0.00	0.00	0.00	0.00	0.00
	Untreated Control	0.07	1.66	0.07	0.11	0.58	0.10	0.00	0.01	0.03	0.00	0.00	0.00
TARLEE	Chlorpyrifos	0.00	0.17	0.01	0.02	0.90	0.27	0.00	0.00	0.00	0.00	0.00	0.00
	Gaucho	0.00	0.08	0.16	0.00	0.77	0.21	0.00	0.01	0.01	0.00	0.00	0.00
	Untreated Control	0.00	0.49	0.01	0.00	0.70	0.12	0.00	0.02	0.00	0.00	0.00	0.00

Aphid populations were very low in all sites, sowing dates, commodities and treatments. Only in the second time of sowing some spillover from inoculated plots was observed.
Oat aphids were only observed in Keith. No corn aphids were observed in 2018

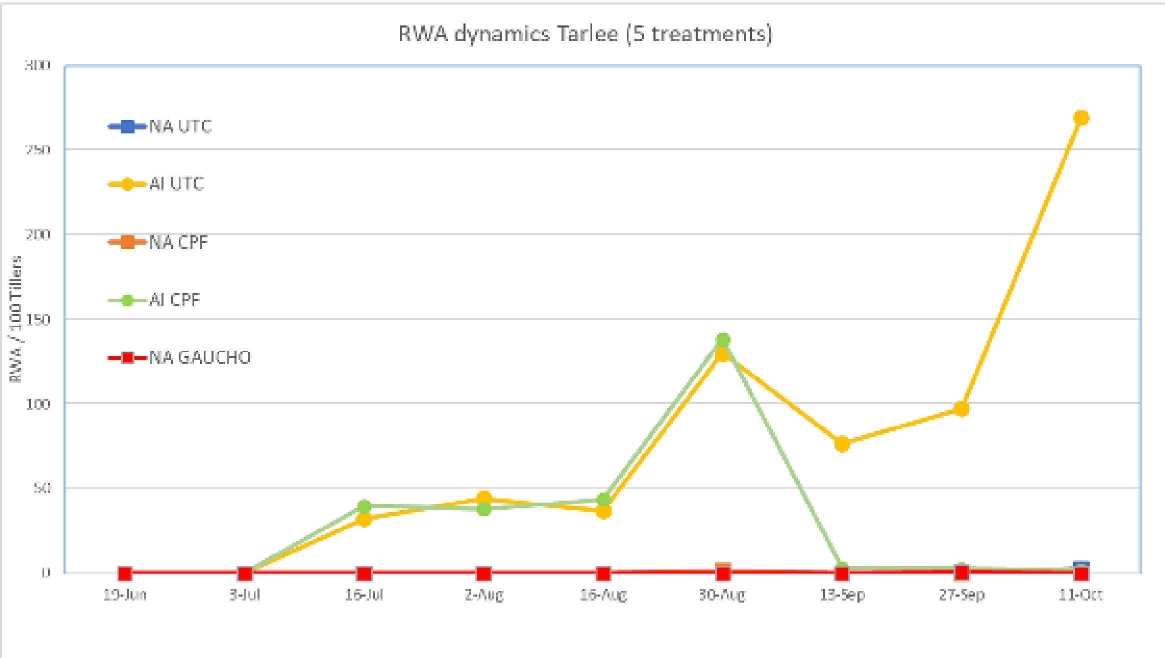
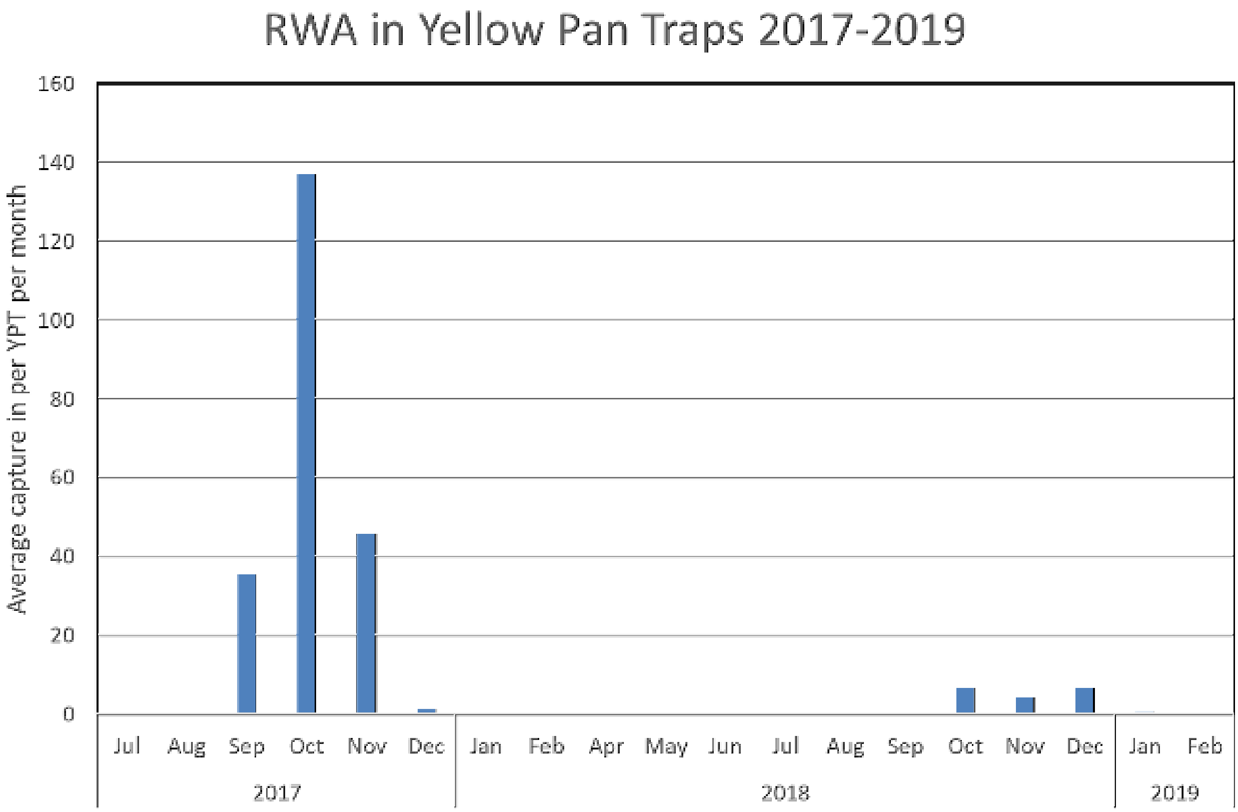
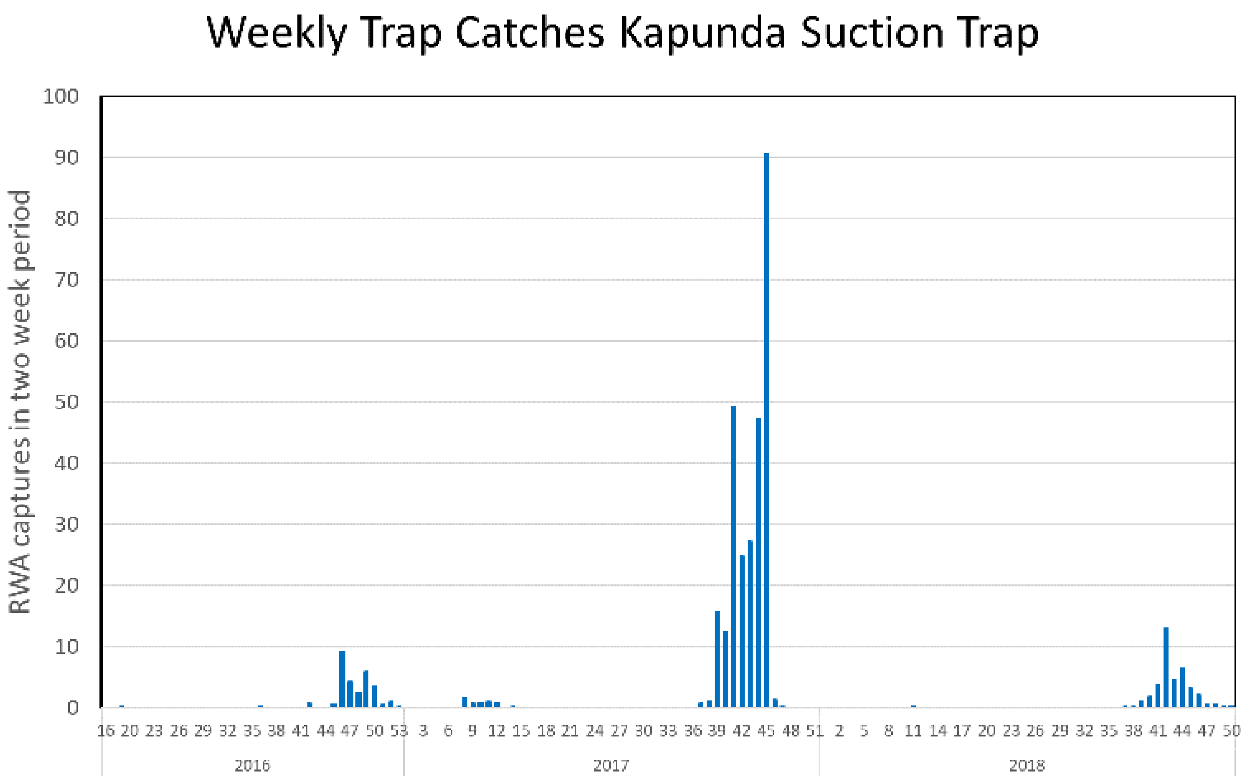


Figure 1: Aphid dynamics in Tarlee site. This includes the two artificially inoculated treatments (GRDC Project). NA UTC = Natural infestation Untreated Control; AI UTC = Artificially infested Untreated Control, NA CPF = Natural infestation Chlorpyrifos treated; AI CPF = Artificially infested Chlorpyrifos treated; NA Gaucho = Natural infestation Gaucho Treated.

Only in the artificially inoculated treatments there were significant aphid numbers observed.

Attachment 2: RWA captures in yellow pan traps (2017-2019) and Suction trap (Kapunda 2016-2018). Note weak autumn migration (March/April) recorded ONLY in suction trap

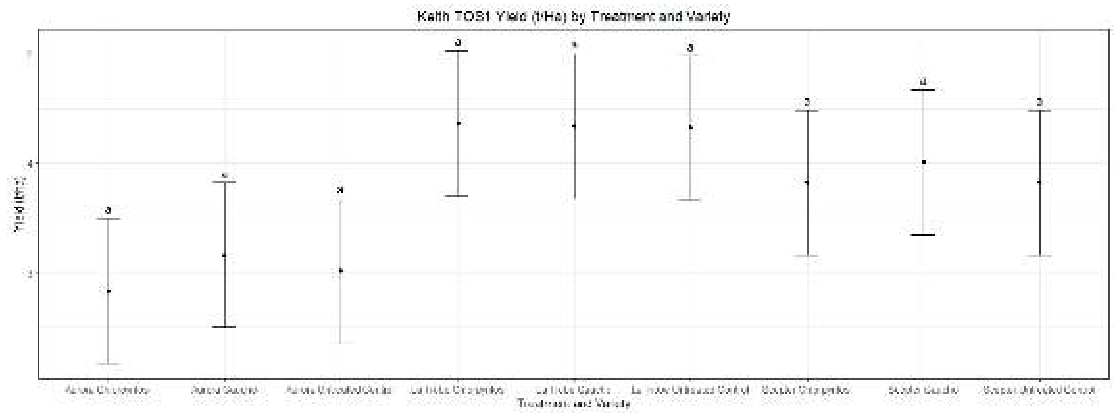


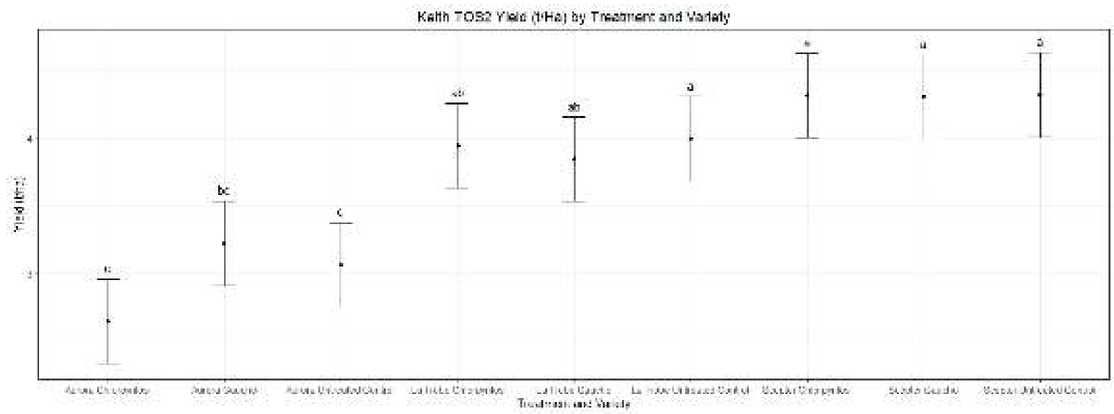


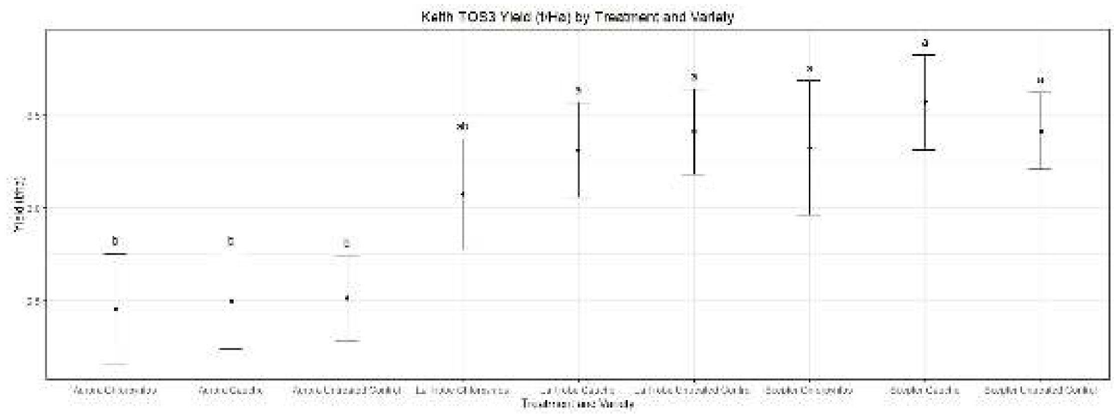
Attachment 3: Yield per site.

Each graph shows the yield (ton/ha) for a single TOS for all treatments and commodities/varieties. When the bars of the three treatments for a specific commodity have a letter in common they are not significantly different.

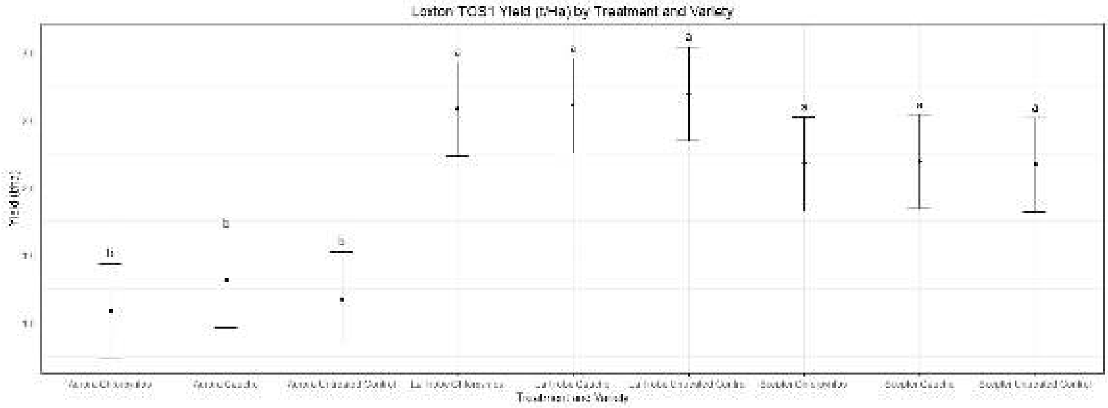
KEITH:
Early sowing gave highest yield for La Trobe barley and Aurora durum, whereas the Scepter wheat seemed less sensitive to sowing date. No treatment effect was observed

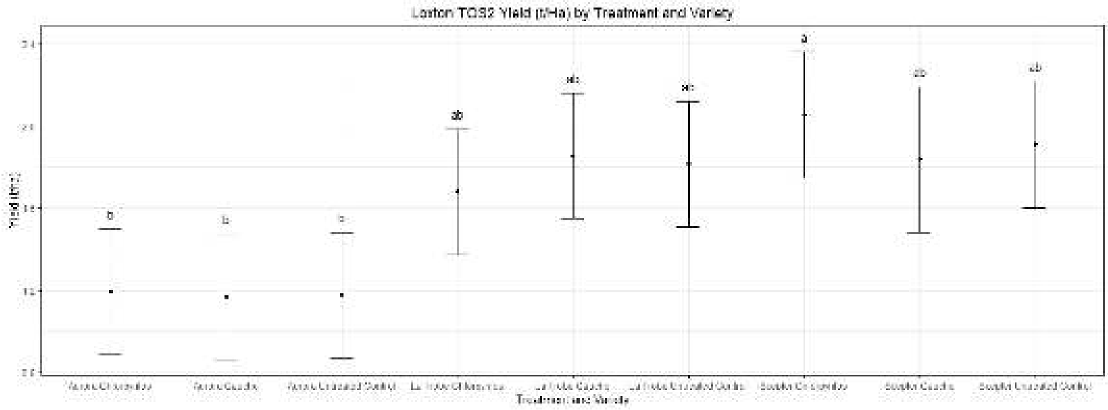


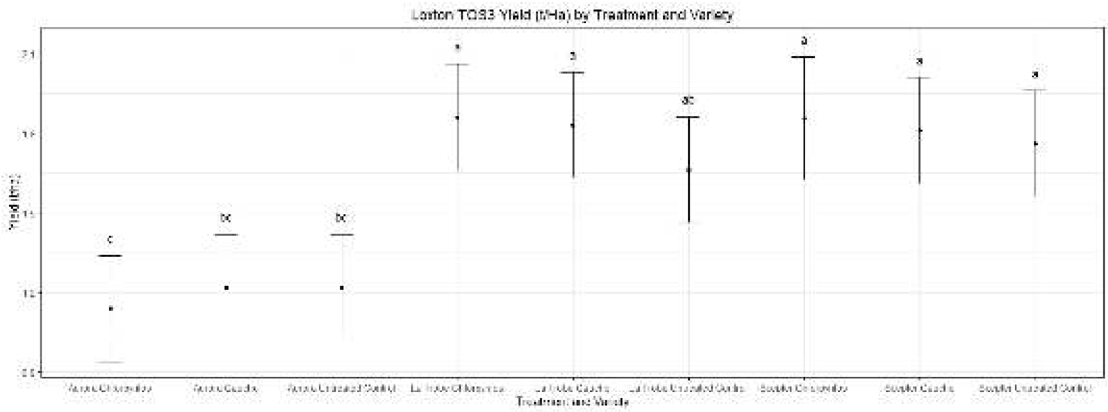




LOXTON:
Note that overall yield is low in Loxton, especially for the Aurora Durum Wheat. Early sowing gave higher yield for all commodities. No treatment effect was observed







TARLEE:

In Tarlee the highest yield (all commodities) was obtained for the second sowing date. No treatment effect was observed