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## TITLE:

# PHENOTYPIC COMPARISON OF AGRONOMIC AND SEED TRAITS FOR DHA CANOLA IN AUSTRALIA AND CANADA

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## I. ABBREVIATIONS

CFIA	Canadian Food Inspection Agency
CI	Confidence interval
CSIRO	Commonwealth Scientific and Industrial Research Organization
CV	Coefficient of variation
DHA	Docosahexaenoic acid, 22:6 $\omega$ 3
GC-FID	Gas Chromatography-Flame Ionization Detector
LSD	Least significant difference
NMR	Nuclear magnetic resonance
OA	Oleic acid
OECD	Organisation for Economic Co-operation and Development
OGTR	Office of the Gene Technology Regulator
$\omega$ 3 LC-PUFA	Omega-3 long-chain ( $\geq$ C20) polyunsaturated fatty acids
PCR	Polymerase chain reaction
REML	Restricted maximum likelihood
SD	Standard deviation
VAR	Variance

## II. EXECUTIVE SUMMARY

DHA canola (OECD ID NS-B50027-4) has been field tested at ten sites in major canola growing regions of Australia and Canada. All field tests were conducted under field permits granted by the OGTR in Australia and CFIA in Canada. Agronomic performance assessments were conducted in multi-site field studies to measure characteristics such as emergence, seedling vigor, plant height, lodging, and yield. All field trials were also observed for opportunistic disease or insect stressors as well as normal phenotypic characteristics. Based on field observation at these sites, pathogen susceptibility or resistance characteristics of the DHA canola were unchanged when compared to those of the non-transformed cultivar. The DHA canola remains resistant or tolerant to blackleg (*Leptosphaeria maculans* + *L. biglobosa*). There were no meaningful differences observed between DHA canola and the non-transgenic control (Jade) for plant pest characteristics and no indication of a selective advantage that could result in increased weediness potential of DHA canola. Six DHA-expressing transgenic lines were compared to eight Australian cultivars across 10 experimental locations (sites) for a range of important agronomic and seed traits. The 10 sites represented diverse environmental yield potentials as indicated by the wide range of site mean yields [REDACTED]. Agronomic trait variation of the transgenic lines was comparable to that of the commercial cultivars evaluated across all environments tested. This was supported by the finding that the grain yield of the highest yielding transgenic lines was statistically comparable to the highest yielding commercial cultivars based on an across site analysis (MET-REML). It was observed that DHA canola was not associated with reduced yield or agronomic performance.

## III. INTRODUCTION

Agronomic and ecological evaluations were conducted to compare DHA canola to conventional canola, to help show that DHA canola is no more likely to pose a plant pest risk than conventional canola. Agronomic evaluations were based on laboratory and replicated, multi-site field trials conducted by agronomists and scientists who are experts in the production and evaluation of canola. To evaluate its agronomic characteristics, data were collected on representative characteristics that influence reproduction, crop survival, and potential weediness. In each of these assessments, DHA canola was compared to a near-isoline control that was >95% genetically similar but did not carry any recombinant DNA.

There are many similarities in agronomic practices used in canola production between North America (USA and Canada) and Australia, including weed, insect and disease control practices. Canola varieties have been adapted over years to a wide range of climatic conditions, and data from this study suggests that Australian varieties can also be grown in North America. The data generated in the field trials conducted in Australia and Canada are

equally applicable in support of environmental as well as food and feed safety of DHA canola.

In Australia, canola is grown across the southern dryland cropping zone and mostly within winter-dominant rainfall environments. Australian production is mostly from spring type canola cultivars that have low vernalisation requirements. In general, Australian cultivars typically retain some minor delay in the onset of flowering and have relatively high plant vigour or biomass production over winter months. The canola crop in Australia is typically sown after the first major rainfall event from April to May. Yield is primarily determined by available water during the growing season and water use efficiency of the cultivar. Major pathotype gene resistance to the disease blackleg caused by *Leptosphaeria maculans* can differentiate cultivars in terms of seedling survival and stem cankering, however, in general Australian cultivars are considered to have high resistance. Seed development occurs in late spring or early summer, following a growing season of 5 to 7 months. Apart from water availability, yield can be negatively impacted from large temperature extremes (+35°C to < 0°C) that may cause seed and pod abortion.

In North America, spring canola is grown in the western provinces of Alberta, Saskatchewan and Manitoba. British Columbia, Ontario and Quebec also grow a substantial amount. New varieties are pushing the boundaries of where canola is being successfully grown. It is now grown in the Pacific Northwest states and across other US states that border Canada, with most of the US production in North Dakota. A few southern states produce a limited amount of canola. Fall-planted canola overwinters and some varieties require vernalization over the winter months to produce flowers. Vernalized canola is targeted for the Pacific Northwest, Great Plains and Midwest regions. Winter canola that produces flowers without vernalization is usually planted in the southeast region of the US. (Brown et al. 2008). In Canada, seeding in late April is fairly common in the Brown and Dark Brown soil zones, and has been tried in Black and Grey Wooded zones. April-seeded canola faces higher risks from early insect infestations, seedling disease pressures, water ponding in the field, soil crusting, frost damage, and slow emergence due to cold soil. But under the right conditions, seeding in late April can provide an added yield benefit over May seeding. Although April-seeded canola suffers higher seedling mortality, the plants that survive have more time to branch out and compensate for a thinner stand. Canola seeded in early spring yields as well as or better than fall seeded canola (spring type canola seed planted late enough in fall that cold soil prevents germination until the following spring). With the high value of canola seed, growers are less inclined to take a risk on fall seeding when early spring seeding provides similar or superior yield potential. Thus, fall seeding in western Canada is not recommended. Seeding in the fall is common practice among canola growers in southern Ontario, but the winter hardiness of these varieties remains inadequate for use on the prairies (Canola Council 2013).

In collaboration with the Commonwealth Scientific and Industrial Research Organization (CSIRO), Nuseed Pty Ltd has developed genetically modified canola event NS-B50027-4 (DHA canola), that accumulates significant amounts of DHA in the seed oil. In this DHA canola, seven fatty acid desaturases and elongases were introduced to convert oleic acid (OA)

to DHA in a single pathway expression vector (Petrie et al. 2012). Transformed material was reselected for locus homozygosity, expression of DHA in the seed and suitable agronomic and yield potential equivalent to canola for production.

DHA canola was field tested in representative canola growing regions of Australia for the last three years (2014-2016) and two locations in Canada during the summer of 2016. The data from trial sites from 2015-2016 are presented herein.

All field trials of DHA canola were observed for naturally occurring disease or insect biotic stressors.

## IV. MATERIALS AND METHODS

In 2015, field trial experiments “Sites” were sown across eight locations (Table 1, Figure 1) in Western Victoria. Each trial was designed as a randomized complete block experiment consisting of 5 replicates (bloc) by 14 treatment entries (6 transgenic lines and 8 cultivars). In 2016, one site was planted in Alberta and another in Saskatchewan, Canada. Each of those two trials was also a randomized complete block design and had 5 replicates by 12 treatment entries (2 transgenic lines and 10 cultivars).

### A. DESCRIPTION OF FIELD TRIALS

The experimental sites were located across varying environments for soil type and rainfall and agronomic management practices.

**Table 1.** List of experimental trials, location and code names.

Site Name	Location	Site synonym name
1506_NAR	NURRABIEL	NAR
1507_NARBL	NURRABIEL-BL	NARBL
1508_DOU	DOUGLAS	DOU
1509_GRN	GREEN LAKE	GRN
1510_TOO	TOOLONDO	TOO
1512_GYM	GYMBOWEN	GYM
1513_KAN	KANIVA	KAN
1514_ARA	ARARAT	ARA
Coalhurst	COALHURST, CANADA	CH
Vanguard	VANGUARD, CANADA	VG







**Table 2.** Average Monthly Rainfall (mm) during the Canola Growing Season.

Cities listed are those closest to the individual field trial locations where DHA Canola was evaluated.

<b>Australia</b>	<b>Latitude</b>	<b>Apr</b>	<b>May</b>	<b>Jun</b>	<b>Jul</b>	<b>Aug</b>	<b>Sep</b>	<b>Oct</b>	<b>Tot</b>
Horsham	36.7	32	47.2	50.2	47.3	48.8	46.7	44.7	317
<b>Canada</b>	<b>Latitude</b>	<b>Apr</b>	<b>May</b>	<b>Jun</b>	<b>Jul</b>	<b>Aug</b>	<b>Sep</b>	<b>Oct</b>	
Lethbridge	49.6° N	31.3	53.5	63	47.5	45.8	39.6	18.9	300
Regina	50° N	4.45	11.7	16.4	18.75	18	11.65	4.75	313

**Table 3.** Average Monthly Temperatures (°C) during the Canola Growing Season.

Cities listed are those closest to the individual field trial locations where DHA Canola was evaluated.

<b>Australia</b>	<b>Latitude</b>	<b>Apr</b>	<b>May</b>	<b>Jun</b>	<b>Jul</b>	<b>Aug</b>	<b>Sep</b>	<b>Oct</b>
Horsham	36.7	14.9	11.65	9.15	8.5	9.7	11.55	14.05
<b>Canada</b>	<b>Latitude</b>	<b>Apr</b>	<b>May</b>	<b>Jun</b>	<b>Jul</b>	<b>Aug</b>	<b>Sep</b>	<b>Oct</b>
Lethbridge	49.6° N	6	11.2	15.45	18	17.7	12.6	7
Regina	50° N	4.45	11.7	16.4	18.75	18	11.65	4.75

<sup>1</sup>Source: <http://www.world-climates.com/>, accessed January 4, 2017

## B. DESCRIPTION OF ENTRIES

### B.1 Transgenic Line Entries

The six transgenic lines used were selected from T0 plantlets following a breeding re-selection program at the Nuseed Innovation Centre (NIC), Horsham. Selection and advancement of candidate transgenic lines was on the basis of:

- i) Homozygosity of transgenic insert loci as determined by digital PCR and genomic sequencing data;
- ii) Production of long chain omega 3 fatty acid-DHA in the seed following analysis by Gas Chromatography (GC) - Flame Ionization Detector (FID) (GC-FID);
- iii) Suitable agronomic traits through progeny testing and seed increases at three locations in Victoria over winter and summer in 2014 (for selection purposes only and thus not reported herein) and 2015.

### B.2 Canola Cultivar Entries

The Australian cultivar entries used for comparison represent an agronomically diverse (i.e. plant habit, phenology) range of well-adapted (i.e. high but varying yield potentials) and widely grown cultivars in the Australian cropping zone (Table 5). These cultivars are all open pollinated and described and extensively evaluated in the Australian National Variety Testing Program and Regional annual crop reports (<http://www.nvtonline.com.au>). Variation for plant disease resistance is well described for blackleg in Australia (Van De Wouw et al. 2015). Other diseases occurring in Australian are not well described in terms of differential cultivar

reactions and are considered highly sporadic and minor in comparison. Plants from the cultivar AV Jade were transformed to produce the transgenic lines described in this report and hence AV Jade can be considered a non-transformed isoline of the transgenic events that are compared.

**Table 4.** Names of experimental entries.

Entry	Line name	Elite event	Transgenic event generation
5	<b>B0050-027-18-20</b>	B0050-027	T3
7	AV Jade	Non Transgenic	
8	AV Zircon	Non Transgenic	
9	AV Garnet	Non Transgenic	
10	ATR Bonito	Non Transgenic	
11	ATR Gem	Non Transgenic	
12	ATR Wahoo	Non Transgenic	
13	ATR Stingray	Non Transgenic	
14	Monola 515TT	Non Transgenic	

**Table 5.** Details of cultivar comparators and characteristics.

Entry	Line name	Flowering	Maturity	Height
7	AV Jade	Mid Season	Mid	Tall
8	AV Zircon	Mid Season	Mid	Tall
9	AV Garnet	Mid Season	Mid	Tall
10	ATR Bonito	Early to Mid Season	Early to Mid	Medium Height
11	ATR Gem	Early to Mid Season	Mid	Medium
12	ATR Wahoo	Late Season	Mid to Late	Medium
13	ATR Stingray	Early Season	Early	Short
14	Monola 515TT	Late Season	Mid to late	Medium

### C. PHENOTYPIC VARIATION MEASURED

Data were collected to evaluate specific aspects of altered plant pest potential. The assessment encompasses phenotypic growth and development; germination and dormancy; plant interactions with insects, diseases, and abiotic stressors; and persistence in cultivated fields or areas outside of cultivation.

#### C.1 Plant Emergence

a) **Plant emergence count** was estimated by counting the number of emerged plants approximately 12 days post-sowing. Emerged plants were counted in two one square metre quadrants within each plot across sites. The average of both quadrants was used to estimate the number of plants emerged per square metre and analysed as a trait variate.

b) **A plant emergence score** (Table 6) based on a visual estimate of average plant density per plot was recorded for each plot across all sites and analysed as a trait variate.

**Table 6.** Plant emergence score.

<b>Plant Emergence Score</b>	<b>Plants per square metre</b>
1 Low	0-5
2	5-15
3	15-20
4	20-25
5 Moderate	25-30
6	30-35
7	35-40
8	40-45
9 High	>45

#### C.2 Plant Vigour

**Plant vigour** was predicted early in the growing season using an observation 1 to 9 score (Table 7) of vegetative biomass at plant cabbage stage (i.e. from the 6 leaf stage) for each plot across all sites and analysed as a trait variate.

**Table 7.** Plant vigour score.

<b>Vigour Score</b>	<b>Biomass as % leaf area coverage of plot ground cover</b>
1 Low	< 10
2	10-20%
3	20-30%
4	30-40%
5 Moderate	40-50%
6	60-70%
7	70-80%
8	80-90%
9 High	> 90%

### **C.3 Flowering time (50%)**

Flowering time was recorded as number of days from sowing to when 50% of plants in the plot had at least one open flower. This was recorded for each plot across all trials and analysed as a trait variate.

### **C.4 Flowering end**

Flowering end time was recorded in days from sowing to day when 90-95% of plants in the plot had no open flowers. This was recorded for each plot across all trials and analysed as a trait variate.

### **C.5 Flowering duration**

Flowering duration was the calculated difference between flowering time and end flowering time (expressed as number of days). This was calculated for each plot across all trials and analysed as a trait variate.

Flowering duration = Flowering end day – Flowering time (50%)

### **C.6 Plant height at maturity**

Plant height at dry seed maturity stage was measured from base to growing tip in the centre of the plot. The centre of the plot was used to avoid confounding edge effects likely to be associated with inter-plot spatial area (edge effects). This trait was recorded for each plot across all trials and analysed as a trait variate.

### C.7 Seed shattering at maturity

**Seed shattering count** per 1/8<sup>th</sup> of a square meter was recorded over a 2 week period. Two collection trays were placed between sown rows and beneath the canopy for each plot across locations and analysed as a trait variate.

**Seed shattering score** based on a 1 to 9 scale (Table 8) was recorded at the Gym site based on the number of seeds observed on the ground just prior to harvest and analysed as a trait variate.

**Table 8.** Seed shattering score.

Seed Shattering Score	% of Seed
1: Nil	0
2: Low	0-5
3	5-10
4	10-15
5: Moderate	15-20
6	20-25
7	30-35
8	35-40
9: High	High: +40

### C.8 Plant lodging at maturity

Lodging resistance was recorded as a 1 to 9 score on the basis of angle of plant lean from the base of the plant (Table 9).

**Table 9.** Plant lodging score.

Lodging score	Degree of Angle of ground base
1: Erect (Resistant)	>90
2	80
3	70
4	60
5: Moderate lodging	50
6	40
7	30
8	20
9: Flat (Susceptible)	<10

### C.9 Blackleg disease symptoms

Blackleg leaf severity symptoms representative of *Leptosphaeria maculans* and *Leptosphaeria biglobosa* was recorded as a 1 to 9 score (Table 10) for one replicate across

five sites. Not all plots were scored due lack of observable variation. Symptoms associated with cankering and stem breakage were not observed.

**Table 10.** Blackleg symptom score.

<b>Blackleg score</b>	<b>Leaf area infection</b>
1	0-5%
2	5-10%
3	10-15%
4	15-20%
5	20-25%
6	25-30%
7	30-35%
8	35-40%
9	>40%

#### **C.10 Plant survival at harvest.**

**Plant harvest count** was estimated by counting plants in two one square metre quadrants within each plot across all sites. The average of both quadrants was used to estimate the number of plants per square metre and analysed as a trait a variate.

**Plant survival (%)** was calculated by expressing site means for plant count as a % of site means for plant emergence count:

Plant survival % = (Plant harvest count x 100) / Plant Emergence count.

#### **C.11 Grain yield.**

Grain was harvested when seed was physiologically mature and dry (~approximately 7%) using a plot harvester. Harvest direction was kept consistent (i.e. front to back range for each row) for each trial to avoid harvest direction errors. Dry grain weight for each plot was weighed and converted to units of t/ha based on plot area and analysed as a trait variates.

#### **C.12 Grain moisture %**

The grain moisture at harvest and in the lab sample was recorded and analysed as a trait variate. In the Australian fields, a hand-held moisture meter (Wile 65 Moisture Meter, Farmcomp Agroelectronics) was used on a bulk sample directly at point of harvest. In Canada, a Harvest Master Classic Grain Gauge with an Allegro CX was used at harvest.

In the lab % moisture was determined using an oven drying method based on Australian Oilseed Federation (AOF) method 4-1.5 (Nuseed Test Method, Nus002). This involved a 5

grams sample being oven dried in open tins at 130°C for 1 hour. The samples were cooled in a desiccator for 40 minutes and weighed and % moisture determined as a % loss of mass.

### **C.13 Seed Oil %**

The seed oil % was analysed using spinlock nuclear magnetic resonance (NMR) spectrometer on seed adjusted to 6% moisture. A sample of 5-10 grams of seed sample was weighed into an NMR tube and analysed by the NMR. Seed oil result was determined by gravimetric oil extraction by the FeedTest Laboratory in Werribee, Victoria, Australia. Its software was calibrated using 20 reference samples with known % oil content.

## **D. STATISTICAL ANALYSIS**

Restricted estimated likelihood analysis was undertaken using ASReml (Gilmour et al. 2009) procedures in GenStat (Version 17). A linear mixed model statistical method was used to account for field spatial variation as extensively described and used for field plant breeding and genetics research (Cullis and Gleeson 1991, Smith et al. 2001, Welham et al. 2013). A Meta-REML across site analysis was further undertaken for all traits measured. The treatment line mean, variance (VAR), standard error (SE), least significant difference confidence interval (LSD), coefficient of variation (CV%) and F distribution probability of significant difference (F pr.) are presented for both site specific and across site analysis.

Summary statistics for treatment lines (i.e. Mean, Median, Minimum, Maximum, Range, Standard deviation, Standard error of Mean, Variance, Standard error of variance, and % coefficient of variation) was determined using Genstat (Version 17) for each trait and is presented herein for the preferred candidate and the eight cultivars (Appendix 1).

Additionally, the isogenic line (Jade) was compared to the candidate B0050-027-18-20, and the only significant difference shown is for plant count in 2015 (Table 13).

The student t-Test probability that cultivar trait means are significantly different to the candidate B0050-027-18-20 were determined on the basis of across site data (Appendix 2 and Appendix 3).



## V. RESULTS AND CONCLUSIONS

In each experiment, DHA canola was agronomically comparable to the control or commercial comparator lines and showed no biologically meaningful differences. These observations also tracked the presence of insect and disease stressors and the plant responses in the field. In each case, DHA canola responded similarly to the control plants in these trials. Based on the analyses, DHA canola is comparable to conventional canola and would not pose a greater plant pest risk or increased weed potential than does conventional canola. These data support the conclusion of agronomic comparability of DHA canola with commercially available canola regarding lack of increased weediness and plant pest potential.

### A. ACROSS SITE ANALYSIS

Across site analysis of all agronomic traits indicates that the candidate B0050-027-18-20 means falls significantly within the range of cultivar means (Table 11).

Across site analysis of all measured grain quality traits in Australia indicates that for the candidate grain moisture fall significantly within the range of the cultivar means. The analysis also shows as expected that the seed oil % vary significantly from the control cultivars due to the transgenic trait (Table 12). See Tables 14 and 32 for seed oil % in Canada. Across site variance analysis for comparable traits across Australia and Canada are presented in Table 13.

### B. GRAIN YIELD

Site mean grain yield expressed as t/ha varied [REDACTED] (Table 14) and is an indication of the effect of large environmental differences for this trait. The data is also presented as a % cultivar of the AV Garnet (Table 15), which was the highest yielding variety in this study on average, as well as the most widely grown OP cultivar in Australia. There were significant line differences in 9 of the 10 sites for grain yield. Statistically the variation for grain for the transgenic lines was significantly within the range expressed by the cultivars across all experiments. Predictions from an across site Meta analysis further indicates the transgenic lines show relatively comparable adaptation across the sites tested for grain yield.

### C. PLANT EMERGENCE

Plant emergences based on number per square meter (Table 16) and plant emergence score (1-9) (Table 17) varied significantly between line treatments for all 8 sites where recorded. Statistically variation for plant emergence of the transgenic lines was significantly within the range expressed by the cultivars across all experiments.

#### D. FLOWERING TIME

Start of flowering (number of days from sowing), based on 50% of plants flowering (Table 18) varied significantly between line treatments between sites. The site mean flowering time varied from 99 to 110 days in Australia, and 46 to 51 in Canada. These ranges indicate the effects of environmental differences across experimental sites for this trait. Statistically, the variation for flowering time of the transgenic lines was significantly within the range expressed by the cultivars across all experiments.

#### E. FLOWERING DURATION

Flowering duration (days) which is calculated from the difference between flowering time and end of flowering time, varied significantly between line treatments between sites (Table 19). The site mean flowering time varied from 24 to 30 days and is an indication of environmental differences across experimental sites for this trait. Statistically, the variation for flowering duration of the transgenic lines was significantly within the range expressed by the cultivars across all experiments.

#### F. FLOWERING END

Flowering end (number of days from sowing) based on 90% of plants having no flowers, varied significantly between line treatments between sites (Table 20). The site mean end of flowering time varied from 128 to 141 days in Australia, and 75 to 78 days in Canada. Flowering end is an indication of environmental differences across experimental sites for this trait. Statistically, the variation for end of flowering for the transgenic lines was significantly within the range expressed by the cultivars across all experiments.

#### G. PLANT SURVIVAL AT HARVEST

Plants at harvest based on plants per square meter (Table 21) varied significantly between line treatments for all eight Australian sites. Statistically the variation for plant number at harvest time for the transgenic lines was significantly within the range expressed by the cultivars across all experiments. The number of plants at emergence was significantly correlated to number of plants recorded at harvest (Figure 4). The calculated survival % (Table 22) when greater than 100% is an indication of slow emergence of seedlings as was expressed by the two cultivars ATR Wahoo and AV Jade. In these instances not all seedlings had emerged at the time plant emergence counts were recorded.

#### H. PLANT HEIGHT AT MATURITY

Plant height at maturity (cm), varied significantly between line treatments for all eight Australian sites (Table 23). The site mean plant height varied from 63 to 105 cm and is an indication of environmental differences across experimental sites for this trait. Statistically,

the variation for height of maturity for the transgenic lines was significantly within the range expressed by the cultivars across all experiments.

#### I. PLANT LODGING AT MATURITY

There was no variation for plant lodging at maturity based on a 1 to 9 scale observed across all eight Australian sites (Table 24). The lack of variation for this trait is likely to be associated with below average rainfall at late pod fill stage. Statistically, the variation for lodging at maturity for the transgenic lines was not significantly different to cultivars at the sites when data was recorded.

#### J. GRAIN MOISTURE % AT HARVEST

Grain moisture at harvest (%) (Table 25) varied significantly between line treatments for all sites. The site mean grain moisture at harvest varied from 9 to 12% which indicates that the experiments were harvested at a similar grain stage. Statistically the variation for grain moisture at harvest for the transgenic lines was significantly within the range expressed by the cultivars across all experiments. In Australia the grain moisture % at harvest was associated with flowering time (Figure 5) such that seed of later flowering lines ATR Wahoo, Monola515TT had significantly higher grain moisture % across all sites at harvest time.

#### K. SEED SHATTERING AT MATURITY

Seed shattering based on number of seeds on the ground at harvest (Table 26) varied significantly between line treatments for 4 of the 9 sites where it was recorded. The site mean seed shattering number varied from 3 to 15 (per 1/8<sup>th</sup> of a square meter) and indicates low levels of shattering across all sites. Seed shattering score based on a 1 to 9 scale recorded at the GYM site (Table 27) also varied significantly between line and was closely correlated with the across site mean seed shatter count (Figure 6). This indicates that shattering recorded as a score was a good predictor of number of seed shattering. Statistically the variation for seed shattering based on seed counts and score for the transgenic lines was significantly within the range expressed by the cultivars across all experiments.

#### L. PLANT VIGOUR

Plant vigour based on a 1 to 9 score varied significantly between line treatments for 9 sites where it was recorded (Table 28). Plant vigour was only recorded for one replicate at the ARA site. The variation for site plant mean vigour score was relatively consistent across sites, indicating low environmental effects for this trait. Statistically the variation for plant vigour for the transgenic lines was significantly within the range expressed by the cultivars across all experiments.

#### M. BLACKLEG DISEASE SYMPTOMS

Blackleg disease leaf symptoms observed were at very low levels at all sites (Table 29). The NARBL site was sown using bare seed (untreated with fungicide) and showed no differential line emergence which indicates sufficient or relevant race specific disease resistance were present in all lines. Leaf symptoms are not always predictive of the degree of stem cankering caused by *L. maculans* which is the main cause of yield loss and basis for resistance rating in Australia (Sosnowski et al., 2004). Given the lack of cankering and stem breakage, all lines can be considered resistant to the disease pressure present in this study.

#### N. SEED MOISTURE % (LAB)

The seed moisture at the lab varied significantly between line treatments across sites (Table 30). However the differences between lines and across sites are very low and average around 7%. This indicates no confounding effects of seed storage. Statistically the variation for seed moisture in the lab for the transgenic lines was significantly within the range expressed by the cultivars across all experiments.

#### O. SEED OIL %

The seed oil % as analysed using NMR on seed adjusted to 6% moisture varied significantly between line treatments across all 10 sites (Table 31). In Australia the site mean seed oil % varied [REDACTED] which is generally below the average for Western Victoria and is a likely consequence of below average rainfall and higher than average temperatures experienced during the grain fill period. The relative line treatment differences were very consistent across sites, which indicate very little environmental effects on this trait. Statistically the variation for seed oil% for the transgenic lines was significantly lower than the cultivars across all experiments on average by 2%. This expected result is associated with the transgenic insert and will not affect agronomy or grain production commercially.

**Table 11.** Across site META-REML analysis of agronomic traits in Australia.

Line name	Trait	Harvest												Grain moisture at harvest	
		Emergence		Plant Count		Emergence		Plant Vigour		Flowering		Flowering			Shattered Seed
		Plant per m sq	Plant per m sq	Score (1-9)	Score (1-9)	Plant Vigour	Score (1-9)	Flowering Start	Flowering End	Flowering Day	Flowering Days	Height at Maturity	cm		
Unit													No.	%	
ATR Bonito		18.2	16.0	7.3	6.8	103.8	131.2	27.5	90.0	13.0				10.6	
ATR GEM		17.9	16.6	7.1	6.7	105.3	133.6	28.2	91.0	10.9				13.0	
ATR Stingray		17.6	17.3	7.1	5.9	100.9	129.7	28.8	82.7	14.4				8.2	
ATR WAHOO		11.2	11.8	5.9	6.1	108.2	136.0	27.3	92.3	10.7				18.7	
AV GARNET		18.6	16.3	7.4	7.2	104.4	132.8	28.6	102.1	15.0				10.2	
AV JADE		7.8	12.5	5.0	4.8	106.7	134.8	28.3	89.9	9.8				9.9	
AV ZIRCON		19.0	15.7	7.3	7.0	104.4	132.0	27.6	98.7	22.5				9.5	
Monola 515TT		20.3	18.5	7.5	5.8	108.6	136.1	27.3	87.9	12.3				12.4	
LINE A		19.5	17.9	7.3	6.4	101.4	132.4	31.3	89.9	8.3				8.9	
LINE C		20.8	19.7	7.4	6.4	101.1	132.4	31.4	88.6	10.4				9.9	
LINE B		17.5	14.6	7.1	6.0	102.0	131.5	29.7	92.3	8.4				9.6	
B0050-027-18-20		18.1	15.7	7.1	5.9	107.8	135.0	27.2	88.2	10.5				11.0	
LINE D		22.5	20.3	7.2	5.9	106.6	134.4	27.9	76.4	10.3				10.8	
LINE E		22.6	19.8	7.6	5.4	108.5	135.8	27.3	70.6	8.9				11.1	
Min Cultivar Value		7.8	11.8	5.0	4.8	100.9	129.7	27.3	82.7	9.8				8.2	
B0050-027-18-20		18.1	15.7	7.1	5.9	107.8	135.0	27.2	88.2	10.5				11.0	
Max Cultivar Value		20.3	18.5	7.5	7.2	108.6	136.1	28.8	102.1	22.5				18.7	
Mean		17.6	16.4	7.0	6.2	104.7	133.2	28.5	90.0	12.0				11.0	
VAR		0.67	0.98	0.02	0.01	0.04	0.07	0.13	1.35	2.74				0.15	
SE		0.81	0.98	0.14	0.11	0.21	0.27	0.35	1.15	1.65				0.39	
LSD		1.62	1.95	0.28	0.21	0.41	0.54	0.71	2.30	3.30				0.78	
CV%		4.6	6.0	2.0	1.7	0.2	0.2	1.3	1.3	13.8				3.6	
Analysis		REML	REML	REML	REML	REML	REML	REML	REML	REML				REML	
F pr		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001				<0.001	
		Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig				Sig	

**Table 12.** Across site META-REML oil analysis of seed traits in Australia



**Table 13.** Across site META-REML variance components analysis for comparable traits across Australia and Canada.

Line name	Early Plant	End of	Flowering	Flowering	Flowering	Grain	Plant	Plant	Plant
	Count	Flowering	Day	Day	50%	moisture	height	(cm)	Vigour
No.						% at	cm		1 to 9
						Harvest			
AV JADE	8.3	132.8	102.3	29.0	9.3	97.6	4.8		
B0050-027-18-20	17.7	132.3	103.7	27.9	10.6	95.4	5.9		
Experimental Mean	18.4	115.8	87.0	28.3	9.7	98.2	6.1		
VAR	8.049	184.8	168.5	0.7285	1.352	16.4	0.365		
SE	2.244	9.426	8.894	0.7007	0.9672	3.452	0.4511		
LSD	4.49	18.85	17.79	1.40	1.93	6.90	0.90		
CV%	15.4	11.7	14.9	3.0	12.0	4.1	9.8		
F pr	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001		<0.001



**Table 14.** Site seed oil % for Canadian experiments following REML analysis.



**Table 15.** Site by line treatment mean grain yields expressed as t/ha


**Table 16.** Site by line treatment mean grain yields expressed as a % of cultivar AV Garnet.





META ANALYSIS			
Tests for fixed effects			
Fixed term	Wald statistic	n.d.f.	F statistic
name	300.85	13	23.14
			d.d.f.
			332.9
			F pr
			<0.001

**Figure 3.** Bar graph for across site Meta analysis means (BLUE) and across site means of grain yield (t/ha) analysed individually using REML. Error bars represent l.s.d for F prob <0.001.

**Table 17.** Site by line treatment mean plant emergence number recorded per square meter.

Line name	Unit	Year												2016		2016		2016		2016		2016		2016	
		2015		2015		2015		2015		2015		2015		2015		2015		2015		2015		2015		2015	
		NAR		NARBL		GYM		TOO		DOU		GRN		KAN		ARA		Across site mean		Vanguard Emergence		Coalhurst Emergence		Across site mean	
		Emergence Plants emerged per m <sup>2</sup>		Emergence Plants emerged per m <sup>2</sup>		Emergence Plants emerged per m <sup>2</sup>		Emergence Plants emerged per m <sup>2</sup>		Emergence Plants emerged per m <sup>2</sup>		Emergence Plants emerged per m <sup>2</sup>		Emergence Plants emerged per m <sup>2</sup>		Emergence Plants emerged per m <sup>2</sup>		Emergence Plants emerged per m <sup>2</sup>		Emergence Plants emerged per m <sup>2</sup>		Emergence Plants emerged per m <sup>2</sup>		Emergence Plants emerged per m <sup>2</sup>	
ATR Bonito		18	15	15	20	20	20	17	17	17	17	21	21	18	18	18	18	18	18	27	27	20	20	23.3	23.3
ATR Gem		16	16	18	18	15	15	22	21	21	21	19	19	18	18	18	18	18	18	22	22	22	22	22.1	22.1
ATR Stingray		17	15	19	19	18	18	20	19	19	19	19	19	17	17	17	17	18	18	21	21	22	22	21.4	21.4
ATR Wahoo		13	18	12	12	7	7	9	9	9	9	12	12	8	11	11	11	11	11	25	25	18	18	21.5	21.5
AV Garnet		16	20	23	18	18	21	21	21	21	21	22	22	16	20	20	20	20	20	34	34	19	19	26.7	26.7
AV Jade		9	9	11	11	5	5	7	11	11	11	6	6	6	8	8	8	8	8	29	29	24	24	26.7	26.7
AV Zircon		19	15	21	21	18	18	18	20	20	20	22	22	18	19	19	19	19	19	17	17	10	10	13.8	13.8
Monola 515TT		18	21	24	19	19	19	19	19	19	19	21	21	21	20	20	20	20	20	30	30	23	23	26.3	26.3
Line A		17	20	18	21	21	21	15	15	15	15	21	21	22	19	19	19	19	19						
Line B		21						21	18	18	17	17	17	17	17	17	17	17	17						
Line C		18	16	19	19	19	19	16	16	16	16	17	17	17	17	17	17	17	17						
B0050-027-18-20		18	19	18	18	15	15	18	18	18	18	21	21	16	18	18	18	18	18	12	12	10	10	11.1	11.1
Line D		22	21	27	27	21	21	27	25	25	25	25	25	19	23	23	23	23	23						
Line E		20	23	18	18	22	22	26	23	23	23	21	21	24	22	22	22	22	22						
Line F																				15	15	17	17	16.4	16.4
DK7444																				25	25	16	16	20.8	20.8
LL130																				22	22	15	15	18.3	18.3
Min Cultivar Value		9	9	11	11	5	5	7	9	9	9	6	6	6	8	8	8	8	8	17	17	10	10	13.8	13.8
B0050-027-18-20		18	19	18	18	15	15	18	18	18	18	21	21	16	18	18	18	18	18	12 - 15	12 - 15	10 - 17	10 - 17	11.1 - 16.4	11.1 - 16.4
Max Cultivar Value		19	21	24	24	20	20	22	21	21	21	22	22	21	21	21	21	21	21	34	34	24	24	26.7	26.7
Mean		17	18	19	19	17	17	18	18	18	18	19	19	17	17	17	17	17	17	24	24	19	19		
VAR		2.22	2.37	10.04	10.04	4.18	4.18	5.87	5.87	5.87	5.87	5.03	5.03	2.53	2.53	2.53	2.53	2.53	2.53	26.67	26.67	5.94	5.94		
SE		1.49	1.54	3.16	3.16	2.04	2.04	2.42	2.42	2.42	2.42	2.24	2.24	1.59	1.59	1.59	1.59	1.59	1.59	5.16	5.16	2.43	2.43		
LSD		2.97	3.07	6.3	6.3	4.1	4.1	4.8	4.8	4.8	4.8	4.48	4.48	3.17	3.17	3.17	3.17	3.17	3.17	10.32	10.32	4.87	4.87		
CV%		8.7	8.8	16.7	16.7	12.2	12.2	13.3	13.3	13.3	13.3	12	12	9.2	9.2	9.2	9.2	9.2	9.2	21.30	21.30	13.1	13.1		
Analysis		REML	REML	REML	REML	REML	REML	REML	REML	REML	REML	REML	REML	REML	REML	REML	REML	REML	REML	REML	REML	REML	REML		
F pr		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.015	0.015	<0.001	<0.001		
Sig		Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig		

**Table 18.** Site by line treatment mean plant emergence 1 to 9 score.

Line name	Year	2015												2015	
		Site												Across site mean	
		NAR	NARBL	GYM	TOO	DOU	GRN	KAN	ARA	Flowering start	Flowering start	Flowering start	Flowering start	Flowering start	Flowering start
Trait		Flowering start	Flowering start	Flowering start	Flowering start	Flowering start	Flowering start	Flowering start	Flowering start	Flowering start	Flowering start	Flowering start	Flowering start	Flowering start	Flowering start
Unit		Days from sowing	Days from sowing	Days from sowing	Days from sowing	Days from sowing	Days from sowing	Days from sowing	Days from sowing	Days from sowing	Days from sowing	Days from sowing	Days from sowing	Days from sowing	Days from sowing
ATR Bonito		104.9	103.2	100.8	108.2	104.9	100.2	98.3	109.7					103.8	
ATR Gem		107	105.7	101.6	110.1	107	101.2	99.5	110.6					105.3	
ATR Stingray		100	102.3	97	105.1	103	96.1	95.7	106.1					100.7	
ATR Wahoo		111.9	108	104.1	113.3	110.9	104.4	101.8	114.8					108.6	
AV Garnet		107	105.4	100.1	109	105	100.5	98.9	109					104.4	
AV Jade		109.4	107.7	102.3	110.6	107.4	102	100.8	113.6					106.7	
AV Zircon		107	104.6	100.4	109.1	105.1	100.8	99.4	108.9					104.4	
Monola 515TT		111.4	109.3	103.9	112.2	109.9	105.5	102.1	115.1					108.7	
Line A		102.1	102	97.4	105.5	102.2	97.7	95.8	108.3					101.4	
Line B		102.2				102.4	96.9	95.5	107					100.8	
Line C		102.9	103.5	97.6	106.6	103	97.6	96.3	108.7					102.0	
B0050-027-18-20		109.8	108.3	103.3	111.4	110.6	104.8	101.9	113.4					107.9	
Line D		108.6	107	101.9	110.2	108.4	103.1	101.3	112.2					106.6	
Line E		109.9	109.8	102.9	111.8	110.8	106	102	115.1					108.5	
Line F															
DK7444															
LL130															
Min Cultivar Value		100	102.3	97	105.1	103	96.1	95.7	106.1					100.7	
B0050-027-18-20		109.8	108.3	103.3	111.4	110.6	104.8	101.9	113.4					107.9	
Max Cultivar Value		111.9	109.3	104.1	113.3	110.9	105.5	102.1	115.1					108.7	
Mean		106.9	105.9	101	109.5	106.6	101.2	99.2	110.9						
VAR		0.09	0.09	0.08	0.79	0.53	0.17	0.1	0.05						
SE		0.3	0.3	0.28	0.89	0.73	0.4	0.32	0.23						
LSD		0.61	0.6	0.6	1.8	1.5	0.8	0.65	0.46						
CV%		0.3	0.3	0.3	0.8	0.7	0.4	0.3	0.2						
Analysis		REML	REML	REML	REML	REML	REML	REML	REML						
F pr		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001						
Sig		Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig						

**Table 19.** Site by line treatment mean number of days from date of sowing to start date of flowering (50%).

Line name	Year										2016		2016		2016	
	2015		2015		2015		2015		2015		2015		2015		2015	
	NAR	NARBL	GYM	TOO	DOU	GRN	KAN	ARA	Across site mean	Vanguard Flowerin g start	Coalhurst Flowerin g start	Across site mean	Vanguard Flowerin g start	Coalhurst Flowerin g start	Across site mean	2016
Trait	Flowering start	Flowering start	Flowering start	Flowering start	Flowering start	Flowering start	Flowering start	Flowering start	Flowering start	Flowering start	Flowering start	Flowering start	Flowering start	Flowering start	Flowering start	Flowering start
Unit	Days from sowing	Days from sowing	Days from sowing	Days from sowing	Days from sowing	Days from sowing	Days from sowing	Days from sowing	Days from sowing	Days from sowing	Days from sowing	Days from sowing	Days from sowing	Days from sowing	Days from sowing	Plants emerged per m <sup>2</sup>
ATR Bonito	104.9	103.2	100.8	108.2	104.9	100.2	98.3	109.7	103.8	45.9	51.6	48.8	45.9	51.6	48.8	
ATR Gem	107	105.7	101.6	110.1	107	101.2	99.5	110.6	105.3	45.7	50.8	48.3	45.7	50.8	48.3	
ATR Stingray	100	102.3	97	105.1	103	96.1	95.7	106.1	100.7	44.7	51.2	47.9	44.7	51.2	47.9	
ATR Wahoo	111.9	108	104.1	113.3	110.9	104.4	101.8	114.8	108.6	46.3	50.5	48.4	46.3	50.5	48.4	
AV Garnet	107	105.4	100.1	109	105	100.5	98.9	109	104.4	46.1	50.4	48.2	46.1	50.4	48.2	
AV Jade	109.4	107.7	102.3	110.6	107.4	102	100.8	113.6	106.7	44.7	50.5	47.6	44.7	50.5	47.6	
AV Zircon	107	104.6	100.4	109.1	105.1	100.8	99.4	108.9	104.4	49.1	50.8	49.9	49.1	50.8	49.9	
Monola 515TT	111.4	109.3	103.9	112.2	109.9	105.5	102.1	115.1	108.7	44.3	49.3	46.8	44.3	49.3	46.8	
Line A	102.1	102	97.4	105.5	102.2	97.7	95.8	108.3	101.4							
Line B	102.2				102.4	96.9	95.5	107	100.8							
Line C	102.9	103.5	97.6	106.6	103	97.6	96.3	108.7	102.0							
B0050-027-18-20	109.8	108.3	103.3	111.4	110.6	104.8	101.9	113.4	107.9	47.5	50.8	49.1	47.5	50.8	49.1	
Line D	108.6	107	101.9	110.2	108.4	103.1	101.3	112.2	106.6							
Line E	109.9	109.8	102.9	111.8	110.8	106	102	115.1	108.5							
Line F										47.2	51.6	49.4	47.2	51.6	49.4	
DK7444										43.2	50.0	46.6	43.2	50.0	46.6	
LL130										44.6	49.6	47.1	44.6	49.6	47.1	
Min Cultivar Value	100	102.3	97	105.1	103	96.1	95.7	106.1	100.7	43.2	49.3	47.1	43.2	49.3	47.1	
B0050-027-18-20	109.8	108.3	103.3	111.4	110.6	104.8	101.9	113.4	107.9	47.2	50.8	49.1	47.2	50.8	49.1	
Max Cultivar Value	111.9	109.3	104.1	113.3	110.9	105.5	102.1	115.1	108.7	49.1	51.6	49.9	49.1	51.6	49.9	
Mean	106.9	105.9	101	109.5	106.6	101.2	99.2	110.9		46.02	50.64		46.02	50.64		
VAR	0.09	0.09	0.08	0.79	0.53	0.17	0.1	0.05		0.19	0.86		0.19	0.86		
SE	0.3	0.3	0.28	0.89	0.73	0.4	0.32	0.23		0.44	0.93		0.44	0.93		
LSD	0.61	0.6	0.6	1.8	1.5	0.8	0.65	0.46		0.88	1.86		0.88	1.86		
CV%	0.3	0.3	0.3	0.8	0.7	0.4	0.3	0.2		0.96	1.8		0.96	1.8		
Analysis	REML	REML	REML	REML	REML	REML	REML	REML		REML	REML		REML	REML		
F pr	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001		<0.001	0.293		<0.001	0.293		
Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig		Sig	NS		Sig	NS		



**Table 20.** Flowering Duration: Site by line treatment mean for number of days flowering from start (50%) to end (90%).

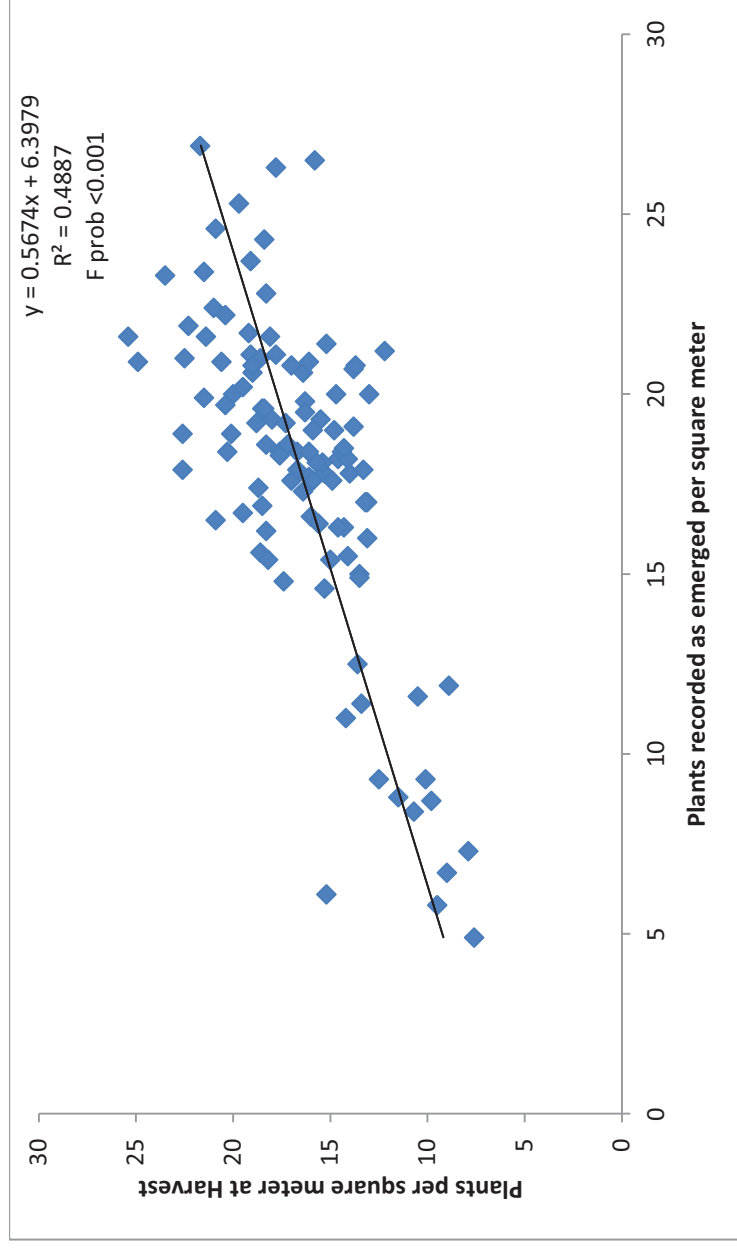
Line name	Year	2015										2016	
		Site										Across site mean	
		NAR	NARBL	GYM	TOO	DOU	GRN	KAN	ARA	Across site mean		Vanguard	Coalhurst
Trait		Flowering Duration	Flowering Duration	Flowering Duration	Flowering Duration	Flowering Duration	Flowering Duration	Flowering Duration	Flowering Duration	Flowering Duration	Flowering Duration	Flowering start	Flowering start
Unit		Days flowering	Days flowering	Days flowering	Days flowering	Days flowering	Days flowering	Days flowering	Days flowering	Days flowering	Days flowering	Plants emerged per m <sup>2</sup>	
ATR Bonito		28.1	31.8	26.1	27.9	28.2	26.4	30	21.6	27.5	27.7	24.3	26.0
ATR Gem		26.4	30.5	27.6	29.8	28.5	28	32.3	22.6	28.2	29.3	25.5	27.4
ATR Stingray		32.1	31.8	27.6	30.3	28.4	30	29.7	23.9	29.2	29.1	24.6	26.9
ATR Wahoo		23.1	28.5	28.5	28.8	28.4	24.2	31.1	24.2	27.1	27.9	26.0	27.0
AV Garnet		27.3	30.6	27.9	30.3	29.8	28	31.4	22.8	28.5	28.7	27.0	27.8
AV Jade		25.1	29.6	28	28.6	29.4	28	31.5	25.4	28.2	29.7	27.9	28.8
AV Zircon		26.6	30.4	26.8	28.8	29.1	27.6	29.8	22.3	27.7	25.8	25.7	25.7
Monola 515TT		24.6	28.3	29.2	29.1	29.1	22	31.1	19.2	26.6	29.2	23.9	26.6
Line A		31.7	33.4	30.2	32.6	31.9	30.2	35	24.2	31.2			
Line B		31.3				32.4	30.1	33.5	25.9	30.6			
Line C		29.9	32.1	28.9	30.3	30	30	33.2	23.8	29.8			
B0050-027-18-20		24.1	28.6	27.3	29.7	27.6	23.6	30.1	26.7	27.2	28.4	26.8	27.6
Line D		25.5	29.8	28.2	30.4	28.5	26.8	28.7	26.8	28.1			
Line E		24	27.1	28.9	29.3	28	24	30.6	26	27.2			
Line F											27.5	25.6	26.6
DK7444											29.0	21.8	25.4
LL130											28.2	23.3	25.7
Min Cultivar Value		23.1	28.3	26.1	27.9	28.2	22	29.7	19.2	26.6	25.8	21.8	25.4
B0050-027-18-20		24.1	28.6	27.3	29.7	27.6	23.6	30.1	26.7	27.2	27.5 - 28.4	25.6 - 26.8	26.6 - 27.6
Max Cultivar Value		32.1	31.8	29.2	30.3	29.8	30	32.3	25.4	29.2	29.7	27.9	28.8
Mean		27	30.2	28.1	29.7	29.3	27.1	31.3	24		28.4	25.19	
VAR		0.3	0.11	0.2	0.56	0.57	0.33	0.28	0.1		0.3083	1.35	
SE		0.55	0.33	0.45	0.75	0.75	0.56	0.52	0.32		0.555	1.16	
LSD		1.1	0.67	0.9	1.5	1.5	1.12	1.05	0.64		1.11	2.32	
CV%		2	1.1	1.6	2.5	2.6	2.1	1.7	1.3		2.0	4.6	
Analysis		REML	REML	REML	REML	REML	REML	REML	REML		REML	REML	
F pr		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001		<0.001	0.002	
Sig		Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig		Sig	Sig	

**Table 21.** Site by line treatment mean number of days to end of flowering from date of sowing.

Line name	Year	2015		2015		2015		2015		2015		2015		2015		2015		2016		2016		2016	
		NAR		NARBL		GYM		TOO		DOU		GRN		KAN		ARA		Across site mean		Vangaurd Coalhurst		Across site mean	
		Flowering End	Days to end of flowering	Flowering End	Days to end of flowering	Flowering End	Days to end of flowering	Flowering End	Days to end of flowering	Flowering End	Days to end of flowering	Flowering End	Days to end of flowering	Flowering End	Days to end of flowering	Flowering End	Days to end of flowering	Flowering End	Days to end of flowering	Flowering End	Flowering End	Days to end of flowering	Flowering End
Unit		Days to end of flowering	Days to end of flowering	Days to end of flowering	Days to end of flowering	Days to end of flowering	Days to end of flowering	Days to end of flowering	Days to end of flowering	Days to end of flowering	Days to end of flowering	Days to end of flowering	Days to end of flowering	Days to end of flowering	Days to end of flowering	Days to end of flowering	Days to end of flowering	Days to end of flowering	Days to end of flowering	Days to end of flowering	Days to end of flowering	Days to end of flowering	Days to end of flowering
ATR Bonito		133.2	135.1	126.9	135.9	135.9	133	135.6	129.3	126.5	128.3	131.3	131.3	131.3	131.3	131.3	131.3	131.3	131.3	131.3	131.3	131.3	131.3
ATR Gem		133.3	136.3	129.1	139.9	139.9	135.6	131.4	126.1	128.3	131.8	133.2	133.2	133.2	133.2	133.2	133.2	133.2	133.2	133.2	133.2	133.2	133.2
ATR Stingray		132	134.1	124.8	135.4	135.4	131.4	126.1	125.4	125.4	125.4	130	130	130	130	130	130	130	130	130	130	130	130
ATR Wahoo		134.9	136.5	132.3	141.9	141.9	139.2	128.5	132.8	132.8	132.8	139	139	139	139	139	139	139	139	139	139	139	139
AV Garnet		134.1	135.9	128.2	138.9	138.9	134.8	128.6	130.2	130.2	131.8	131.8	131.8	131.8	131.8	131.8	131.8	131.8	131.8	131.8	131.8	131.8	131.8
AV Jade		134.4	137.1	130.3	140	140	136.8	129.9	132.4	132.4	139	139	139	139	139	139	139	139	139	139	139	139	139
AV Zircon		133.5	134.9	127.2	137.5	137.5	134.2	128.1	129.1	129.1	131.2	131.2	131.2	131.2	131.2	131.2	131.2	131.2	131.2	131.2	131.2	131.2	131.2
Monola 515TT		136	137.7	133.2	141.2	141.2	139	127.5	133.2	133.2	134.2	134.2	134.2	134.2	134.2	134.2	134.2	134.2	134.2	134.2	134.2	134.2	134.2
Line A		133.8	135.3	127.6	138	138	134.2	127.7	130.9	130.9	132.4	132.4	132.4	132.4	132.4	132.4	132.4	132.4	132.4	132.4	132.4	132.4	132.4
Line B		133.5					134.7	127.4	129	129	133	133	133	133	133	133	133	133	133	133	133	133	133
Line C		132.9	135.5	126.4	137.1	137.1	133.1	127.8	129.6	129.6	132.5	132.5	132.5	132.5	132.5	132.5	132.5	132.5	132.5	132.5	132.5	132.5	132.5
B0050-027-18-20		133.9	136.9	130.4	141	141	138.1	128.5	132	132	140	140	140	140	140	140	140	140	140	140	140	140	140
Line D		134.1	136.9	130.1	140.4	140.4	136.8	129.8	129.9	129.9	139	139	139	139	139	139	139	139	139	139	139	139	139
Line E		133.9	137.1	131.9	141.2	141.2	138.8	130	132.5	132.5	141	141	141	141	141	141	141	141	141	141	141	141	141
Line F																							
DK7444																							
LL130																							
Min Cultivar Value		132	134.1	124.8	135.4	135.4	131.4	126.1	125.4	125.4	130	130	130	130	130	130	130	130	130	130	130	130	130
B0050-027-18-20		133.9	136.9	130.4	141	141	138.1	128.5	132	132	140	140	140	140	140	140	140	140	140	140	140	140	140
Max Cultivar Value		136	137.7	133.2	141.9	141.9	139.2	129.9	133.2	133.2	139	139	139	139	139	139	139	139	139	139	139	139	139
Mean		133.9	136.1	129.1	139.1	139.1	135.9	128.3	130.5	130.5	134.8	134.8	134.8	134.8	134.8	134.8	134.8	134.8	134.8	134.8	134.8	134.8	134.8
VAR		0.17	0.08	0.09	0.4	0.4	0.13	0.17	0.32	0.32	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04
SE		0.41	0.28	0.3	0.63	0.63	0.35	0.4	0.56	0.56	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21
LSD		0.82	0.55	0.6	1.3	1.3	0.7	0.8	1.13	1.13	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42
CV%		0.3	0.2	0.2	0.5	0.5	0.3	0.3	0.4	0.4	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Analysis		REML	REML	REML	REML	REML	REML	REML	REML	REML	REML	REML	REML	REML	REML	REML	REML	REML	REML	REML	REML	REML	REML
F pr		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Sig		Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig

**Table 22.** Site by line treatment mean plant survival number at harvest (plants / sq mt).

Line name	Unit	Year	Site	2015												2015		2015	
				NAR	NARBL	GYM	TOO	DOU	GRN	KAN	ARA	Across site mean	Harvest plant count	Coalhurst					
				Harvest plant count	Harvest plant count	Harvest plant count	Harvest plant count	Harvest plant count	Harvest plant count	Harvest plant count	Harvest plant count								
Trait				Plants / m <sup>2</sup>	Plants / m <sup>2</sup>	Plants / m <sup>2</sup>	Plants / m <sup>2</sup>	Plants / m <sup>2</sup>	Plants / m <sup>2</sup>	Plants / m <sup>2</sup>	Plants / m <sup>2</sup>	Plants / m <sup>2</sup>	Plants / m <sup>2</sup>	Plants / m <sup>2</sup>	Plants / m <sup>2</sup>	Plants / m <sup>2</sup>			
ATR Bonito				16.7	15.3	16.3	13	16	18.5	19.1	14.6	16.2	16.2	23.9					
ATR Gem				18.6	14.3	14.4	13.5	21	16.4	20.1	17.6	17	17	23.3					
ATR Stingray				20.9	17.4	15.5	14	18.5	15.9	18	19.5	17.5	17.5	26.0					
ATR Wahoo				13.6	17	10.5	7.9	9.8	10.1	8.9	10.7	11.1	11.1	25.7					
AV Garnet				18.3	18.4	18.3	15.3	12.2	18.6	21.4	14.1	17.1	17.1	22.9					
AV Jade				12.5	11.5	14.2	7.6	9	13.4	9.5	15.2	11.6	11.6	26.0					
AV Zircon				17.3	15	17	15.4	14.9	14.7	20.4	14.1	16.1	16.1	17.5					
Monola 515TT				20.3	20.6	19.1	18.8	18.3	20.4	18.1	13.7	18.7	18.7	25.1					
Line A				18.7	20	16.7	16.1	18.2	17.2	19	22.3	18.5	18.5						
Line B				24.9				13.8	17.6	16.3	21.5	18.8	18.8						
Line C				15.7	14.6	14.8	14.3	13.1	16.4	13.1	13.2	14.4	14.4						
B0050-027-18-20				16.1	13.8	15.9	13.5	13.3	15.2	15.6	16.1	14.9	14.9	16.3					
Line D				25.4	22.5	21.7	17.8	15.8	20.9	19.7	22.6	20.8	20.8						
Line E				19.5	21.5	22.6	19.2	17.8	23.5	19	18.4	20.2	20.2						
Line F														18.0					
DK7444														23.3					
LL130														20.8					
Min Cultivar Value				12.5	11.5	10.5	7.6	9	10.1	8.9	10.7	11.1	11.1	17.5					
B0050-027-18-20				16.1	13.8	15.9	13.5	13.3	15.2	15.6	16.1	14.9	14.9	16.6 - 18					
Max Cultivar Value				20.9	20.6	19.1	18.8	21	20.4	21.4	19.5	18.7	18.7	26.9					
Mean				18.6	17.06	16.7	14.3	15	17.1	17	16.7			22.96					
VAR				2.7	6.9	2.45	3.44	3.66	7.8	3.71	5.95			2.43					
SE				1.64	2.62	1.56	1.85	1.91	2.71	1.92	2.43			1.56					
LSD				3.28	5.24	3.1	3.7	3.8	5.42	3.84	4.87			3.11					
CV%				8.8	15.4	9.4	12.9	12.7	16.4	11.3	14.6			6.8					
Analysis				REML	REML	REML	REML	REML	REML	REML	REML			REML					
F pr				<0.001	0.001	<0.001	<0.001	<0.001	0.001	<0.001	<0.001			<0.001					
				Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig			Sig					



**Figure 4.** Plants per square recorded as emerged versus plants per square meter recorded at harvest.

**Table 23.** Site by line treatment mean plant survival % based on plants counted emerged.

Line name	Unit	Year	2015												2016					
		Site Trait	NAR		NARB		GYM		TOO		DOU		GRN		KAN		ARA		Across Site Means	Coalhurst
			Survival	%	Survival	%	Survival	%	Survival	%	Survival	%	Survival	%	Survival	%	Survival	%		
ATR Bonito			93	105	82	65	96	109	91	80	90	123								
ATR Gem			119	87	78	90	94	80	106	96	94	113								
ATR Stingray			127	118	80	79	94	84	93	117	99	128								
ATR Wahoo			109	97	91	108	113	109	75	127	103	148								
AV Garnet			113	94	80	86	58	89	99	91	89	127								
AV Jade			134	131	129	155	134	118	164	249	152	120								
AV Zircon			90	97	82	85	85	74	92	77	85	187								
Monola 515TT			110	99	81	98	98	104	84	66	92	94								
Line A			107	100	91	77	118	92	92	102	97									
Line B			119				67	96	84	108	95									
Line C		87	90	78	77	82	95	77	78	83										
B0050-027-18-20		91	72	90	91	74	71	95	88	84	172									
Line D		118	107	81	84	60	85	78	120	91										
Line E		97	92	126	88	68	101	91	76	92										
Line F																				
DK7444											114									
LL130											147									
											149									
Min Cultivar Value		90	87	78	65	58	74	75	66	85	94									
B0050-027-18-20		91	72	90	91	74	71	95	88	84	114 - 172									
Max Cultivar Value		134	131	129	155	134	118	164	249	152	187									
Mean		108	99	90	91	89	93	94	105	96	135									



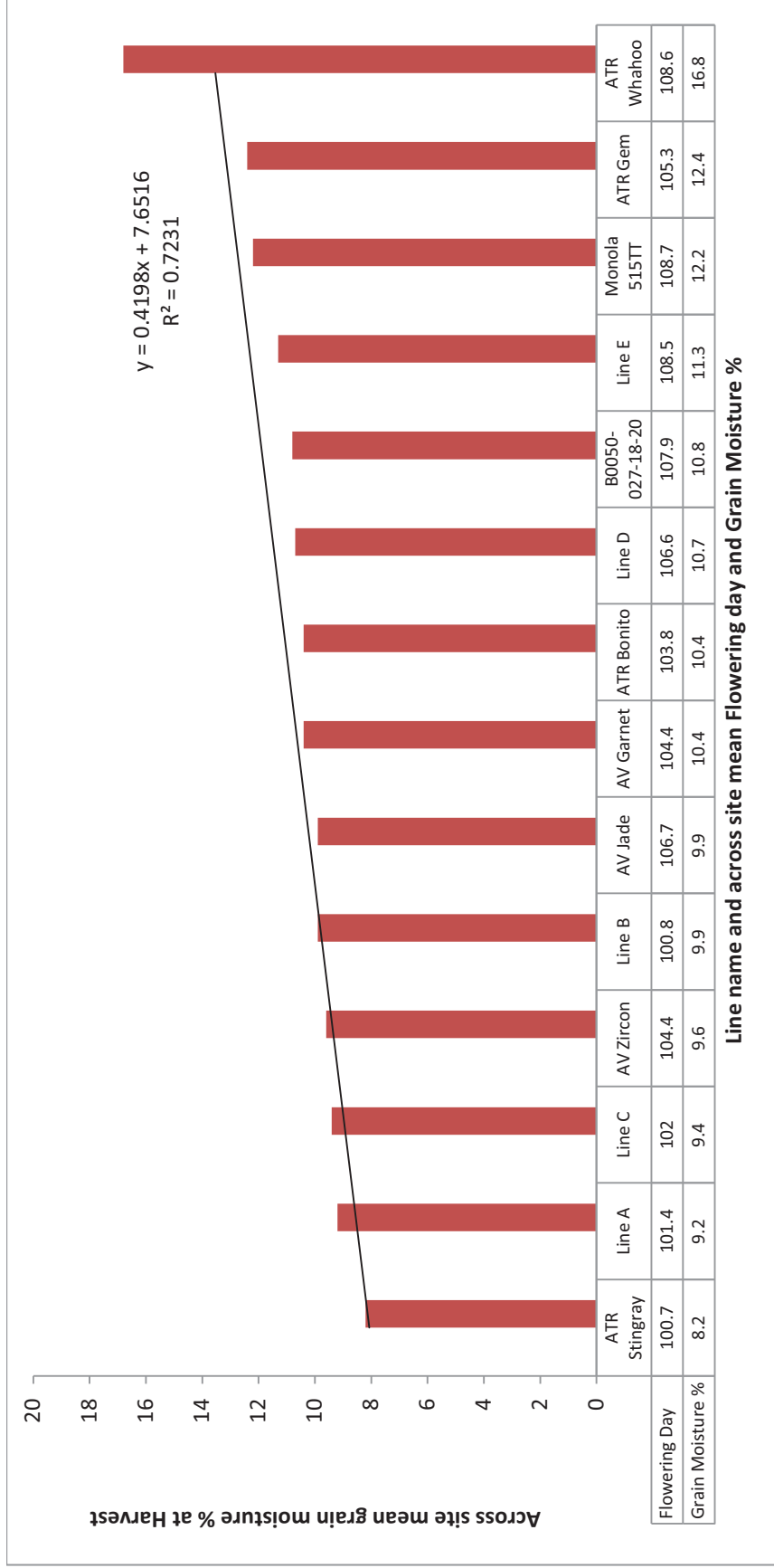
**Table 25.** Site by line treatment mean plant lodging score (1-9) recorded at maturity. All site plots were scored 1 for lodging except NAR.

Line name	Year		2015	
	Site	Trait	NAR	2015
			Seed	Seed
			moisture at Harvest	moisture at Harvest
Unit			(%)	(%)
ATR Bonito			11.3	11.3
ATR Gem			13.2	16.8
ATR Stingray			6.3	6.7
ATR Wahoo			20.4	22.5
AV Garnet			11.1	12.1
AV Jade			8.5	9.7
AV Zircon			8.9	9.9
Monola 515TT			14	16.1
B0050-019-133-11			7.5	7.7
B0050-019-133-17			7.1	
B0050-019-133-31			7.6	8.4
B0050-027-18-20			10.8	11.1
B0050-027-18-36-13			9.6	11.7
B-050-27-18-105-13-CSIRO			9.8	10.6
B0050-027-18-20-12-19				
DK7444				
LL130				
Min Cultivar Value			6.3	6.7
B0050-027-18-20			10.8	11.1
Max Cultivar Value			20.4	22.5
Mean			10.4	11.89
VAR			0.26	0.6
SE			0.51	0.78
LSD			1.02	1.55
CV%			5	6.5
Analysis			REML	REML
F pr			<0.001	<0.001
			Sig	Sig

**Table 26.** Site by line treatment mean grain moisture at harvest expressed as % of total seed weight.

Year	2015																								2015	2016				2016										
	Site		NAR		NARBL		GYM		TOO		DOU		GRN		KAN		ARA		Across site mean		2016		2016			Across site mean														
	Seed	moisture at harvest	Seed	moisture at harvest	Seed	moisture at harvest	Seed	moisture at harvest	Seed	moisture at harvest	Seed	moisture at harvest	Seed	moisture at harvest	Seed	moisture at harvest	Seed	moisture at harvest	Seed	moisture at harvest	Seed	moisture at harvest	Seed	moisture at harvest		Seed	moisture at harvest													
Trait	2015																								2015				2016				2016				2016			
Line name	2015																								2015				2016				2016				2016			
ATR Bonito	11.3	11.3	11.3	11.6	11.7	9.7	10.7	8.4	8.9	10.4	10.4	10.7	8.4	8.9	10.4	10.4	10.7	8.4	8.9	10.4	10.4	10.7	8.4	8.9	10.4	10.4	10.7													
ATR Gem	13.2	16.8	14.1	14.1	14.4	11.9	9.9	8.7	10.3	12.4	12.4	12.4	12.4	12.4	12.4	12.4	12.4	12.4	12.4	12.4	12.4	12.4	12.4	12.4	12.4	12.4	12.4													
ATR Stingray	6.3	6.7	7.4	7.4	8.5	8	11.3	8.4	9.1	8.2	8.2	8.2	8.4	9.1	8.2	8.2	8.2	8.4	9.1	8.2	8.2	8.2	8.4	9.1	8.2	8.2	8.2													
ATR Wahoo	20.4	22.5	22.5	18.8	22.2	18.3	11.4	9.8	11.4	16.8	16.8	16.8	16.8	16.8	16.8	16.8	16.8	16.8	16.8	16.8	16.8	16.8	16.8	16.8	16.8	16.8	16.8													
AV Garnet	11.1	12.1	12.1	10.8	10.3	9.2	10.7	8.6	10.7	10.4	10.4	10.7	8.6	10.7	10.4	10.4	10.7	8.6	10.7	10.4	10.4	10.7	8.6	10.7	10.4	10.4	10.7													
AV Jade	8.5	9.7	9.7	9.1	12.4	9.4	10.1	8.9	11.2	9.9	9.9	9.9	8.9	11.2	9.9	9.9	9.9	8.9	11.2	9.9	9.9	9.9	8.9	11.2	9.9	9.9	9.9													
AV Zircon	8.9	9.9	9.9	8.8	10.7	8.6	10.4	9.4	10.3	9.6	9.6	9.6	9.4	10.3	9.6	9.6	9.6	9.4	10.3	9.6	9.6	9.6	9.4	10.3	9.6	9.6	9.6													
Monola 515TT	14	16.1	16.1	13.6	15	10.8	10.4	8.4	9.2	12.2	12.2	12.2	8.4	9.2	12.2	12.2	12.2	8.4	9.2	12.2	12.2	12.2	8.4	9.2	12.2	12.2	12.2													
Line A	7.5	7.7	7.7	9.5	9.9	8.2	11.2	10.1	9.9	9.2	9.2	9.2	10.1	9.9	9.2	9.2	9.2	10.1	9.9	9.2	9.2	9.2	10.1	9.9	9.2	9.2	9.2													
Line B	7.1					9.6	9.8	9.9	12.9	9.9	9.9	9.9	9.9	12.9	9.9	9.9	9.9	9.9	12.9	9.9	9.9	9.9	9.9	12.9	9.9	9.9	9.9													
Line C	7.6	8.4	8.4	7.5	10.7	9.8	9.9	9.9	11.8	9.4	9.4	9.4	9.9	11.8	9.4	9.4	9.4	9.9	11.8	9.4	9.4	9.4	9.9	11.8	9.4	9.4	9.4													
B0050-027-18-20	10.8	11.1	11.1	11	12.1	10.4	10.7	9.3	10.9	10.8	10.8	10.8	9.3	10.9	10.8	10.8	10.8	9.3	10.9	10.8	10.8	10.8	9.3	10.9	10.8	10.8	10.8													
Line D	9.6	11.7	11.7	10.5	10.1	10.6	10.1	9.4	13.6	10.7	10.7	10.7	9.4	13.6	10.7	10.7	10.7	9.4	13.6	10.7	10.7	10.7	9.4	13.6	10.7	10.7	10.7													
Line E	9.8	10.6	10.6	11.2	11.5	10.6	11.2	10	15.2	11.3	11.3	11.3	10	15.2	11.3	11.3	11.3	10	15.2	11.3	11.3	11.3	10	15.2	11.3	11.3	11.3													
Line F																																								
DK7444																																								
LL130																																								
Min Cultivar Value	6.3	6.7	6.7	7.4	8.5	8	9.9	8.4	8.9	8.2	8.2	8.2	8.4	8.9	8.2	8.2	8.2	8.4	8.9	8.2	8.2	8.2	8.4	8.9	8.2	8.2	8.2													
B0050-027-18-20	10.8	11.1	11.1	11	12.1	10.4	10.7	9.3	10.9	10.8	10.8	10.8	9.3	10.9	10.8	10.8	10.8	9.3	10.9	10.8	10.8	10.8	9.3	10.9	10.8	10.8	10.8													
Max Cultivar Value	20.4	22.5	22.5	18.8	22.2	18.3	11.4	9.8	11.4	16.8	16.8	16.8	9.8	11.4	16.8	16.8	16.8	9.8	11.4	16.8	16.8	16.8	9.8	11.4	16.8	16.8	16.8													
Mean	10.4	11.89	11.89	11.07	12.26	10.4	10.55	9.23	11.09																															
VAR	0.26	0.6	0.6	1.2	0.77	0.25	0.64	0.16	0.51																															
SE	0.51	0.78	0.78	1.09	0.87	0.5	0.78	0.39	0.71																															
LSD	1.02	1.55	1.55	2.2	1.7	1	1.55	0.79	1.42																															
CV%	5	6.5	6.5	9.9	7.1	4.8	7.6	4.3	6.4																															
Analysis	REML	REML	REML	REML	REML	REML	REML	REML	REML																															
F pr	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.495	<0.001	<0.001																															
	Sig	Sig	Sig	Sig	Sig	Sig	NS	Sig	Sig																															





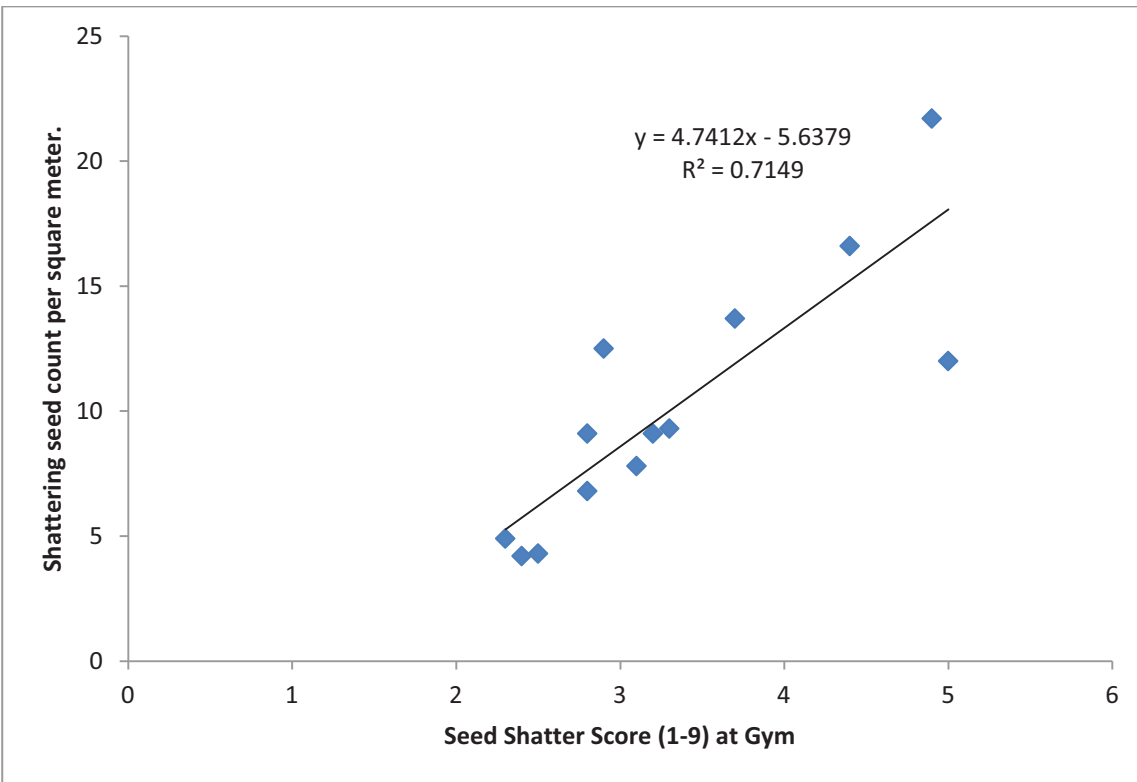
**Figure 5.** Graph of across site mean grain moisture % at harvest graphed against across site mean flowering day.

**Table 27.** Site by line treatment mean seed number shattered recorded per square meter.

Line name	Unit	Year	2015		2015		2015		2015		2015		2015		2015		2015		2015	
			NAR		NARBL		GYM		TOO		DOU		GRN		KAN		ARA		Across site mean	
			Shattered seed	Seed per m <sup>2</sup>	Shattered seed	Seed per m <sup>2</sup>	Shattered seed	Seed per m <sup>2</sup>	Shattered seed	Seed per m <sup>2</sup>	Shattered seed	Seed per m <sup>2</sup>	Shattered seed	Seed per m <sup>2</sup>	Shattered seed	Seed per m <sup>2</sup>	Shattered seed	Seed per m <sup>2</sup>	Shattered seed	Seed per m <sup>2</sup>
ATR Bonito		8.1	3.7	3.7	14.3	4.1	4.1	7	7	10.6	10.6	0	0	14.7	14.7	7.8	7.8	3.3	3.3	
ATR Gem		2.7	19.2	19.2	16.5	5.8	5.8	2.5	2.5	4	4	4.4	4.4	17.8	17.8	9.1	9.1	1.6	1.6	
ATR Stingray		7.3	18.3	18.3	24.9	10.1	10.1	6.5	6.5	4.2	4.2	0	0	28.4	28.4	12.5	12.5	6.2	6.2	
ATR Wahoo		1.4	15.1	15.1	26.6	27.4	27.4	3.5	3.5	3.7	3.7	12.1	12.1	6	6	12	12	4.0	4.0	
AV Garnet		7	17.6	17.6	11.2	40.6	40.6	5.6	5.6	8.7	8.7	7	7	35.4	35.4	16.6	16.6	7.3	7.3	
AV Jade		0.8	6.7	6.7	27.8	9.9	9.9	1.7	1.7	8.4	8.4	12.9	12.9	5.8	5.8	9.3	9.3	3.0	3.0	
AV Zircon		12.4	30.3	30.3	29.3	29.4	29.4	17.1	17.1	25.7	25.7	6.3	6.3	23.4	23.4	21.7	21.7	9.1	9.1	
Monola 515TT		2.6	6.6	6.6	23.8	26.3	26.3	3.8	3.8	12.9	12.9	11.4	11.4	22.1	22.1	13.7	13.7	12.6	12.6	
Line A		0.9	12.3	12.3	9	5.7	5.7	1.2	1.2	0.9	0.9	0.7	0.7	3.8	3.8	4.3	4.3			
Line B		1.4						4.1	4.1	12.5	12.5	0	0	12.4	12.4	6.1	6.1			
Line C		0.6	2.9	2.9	1.5	12.6	12.6	1.3	1.3	4	4	1.7	1.7	9.4	9.4	4.2	4.2			
B0050-027-18-20		1	7.2	7.2	15.6	9.8	9.8	2.5	2.5	7	7	9.3	9.3	20.8	20.8	9.1	9.1	3.8	3.8	
Line D		3	2.1	2.1	8.1	16.3	16.3	3.1	3.1	5.6	5.6	7.6	7.6	8.7	8.7	6.8	6.8			
Line E		2.4	4.3	4.3	6.2	6.7	6.7	1.4	1.4	5	5	6.5	6.5	6.5	6.5	4.9	4.9			
Line F																		2.2	2.2	
DK7444																		3.6	3.6	
LL130																		3.6	3.6	
Min Cultivar Value		0.8	3.7	3.7	11.2	4.1	4.1	1.7	1.7	3.7	3.7	0	0	5.8	5.8	7.8	7.8	1.6	1.6	
B0050-027-18-20		1	7.2	7.2	15.6	9.8	9.8	2.5	2.5	7	7	9.3	9.3	20.8	20.8	9.1	9.1	2.2 - 3.8	2.2 - 3.8	
Max Cultivar Value		12.4	30.3	30.3	29.3	40.6	40.6	17.1	17.1	25.7	25.7	12.9	12.9	35.4	35.4	21.7	21.7	12.6	12.6	
Mean		3.3	11.2	11.2	16.5	15.7	15.7	4.2	4.2	8.1	8.1	5.7	5.7	15.4	15.4			5.66	5.66	
VAR		5.61	43.79	43.79	61.98	174.4	174.4	9.13	9.13	78.93	78.93	26.87	26.87	88.8	88.8			11.72	11.72	
SE		2.36	6.61	6.61	7.85	13.11	13.11	3.02	3.02	8.71	8.71	5.17	5.17	9.4	9.4			3.42	3.42	
LSD		4.73	13.21	13.21	15.7	26.2	26.2	6	6	17.43	17.43	10.34	10.34	18.8	18.8			6.84	6.84	
CV%		70.8	58.9	58.9	47.6	83.9	83.9	72.2	72.2	110	110	90.8	90.8	61.3	61.3			60.5	60.5	
Analysis		REML	REML	REML	REML	REML	REML	REML	REML	REML	REML	REML	REML	REML	REML			REML	REML	
F pr		<0.001	0.002	0.002	0.025	0.093	0.093	<0.001	<0.001	0.295	0.295	0.102	0.102	<0.001	<0.001			0.062	0.062	
		Sig	Sig	Sig	Sig	NS	NS	Sig	Sig	NS	NS	NS	NS	Sig	Sig			NS	NS	

**Table 28.** Site by line treatment mean shattering score (1-9).

<b>Line name</b>	<b>Year Site Trait Unit</b>	<b>2015 GYM Shattering Score (1-9)</b>
ATR Bonito		3.1
ATR Gem		2.8
ATR Stingray		2.9
ATR Wahoo		5
AV Garnet		4.4
AV Jade		3.3
AV Zircon		4.9
Monola 515TT		3.7
Line A		2.5
Line B		
Line C		2.4
B0050-027-18-20		3.2
Line D		2.8
Line E		2.3
Line F		
DK7444		
LL130		
Min Cultivar Value		2.8
B0050-027-18-20		3.2
Max Cultivar Value		5
Mean		3.3
VAR		0.46
SE		0.68
LSD		1.4
CV%		20.4
Analysis		REML
F pr		<0.001
		Sig



**Figure 6.** Seed shattering score at Gym versus across site mean shattering seed count per square meter.

**Table 29.** Site by line treatment mean vegetative plant vigour score (1-9).  
(Data for ARA was for one replicate only)

Line name	Year	2015												2016		2016		2016		2016		2016	
		NAR		2015		2015		2015		2015		2015		2015		2015		2015		2015		2015	
		Plant Vigour		NARBL		GYM		TOO		DOU		GRN		KAN		ARA		Across site mean		Vanguard		Coalhurst	
		Plant Vigour	Plant Vigour	Plant Vigour	Plant Vigour	Plant Vigour	Plant Vigour	Plant Vigour	Plant Vigour	Plant Vigour	Plant Vigour	Plant Vigour	Plant Vigour	Plant Vigour	Plant Vigour	Plant Vigour	Plant Vigour	Plant Vigour	Plant Vigour	Plant Vigour Early	Plant Vigour Early	Plant Vigour Late	Plant Vigour Late
Trait	Unit	Score (1-9)		Score (1-9)		Score (1-9)		Score (1-9)		Score (1-9)		Score (1-9)		Score (1-9)		Score (1-9)		Score (1-9)		Score (1 - 9)		Score (1 - 9)	
ATR Bonito	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7
ATR Gem	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7
ATR Stingray	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
ATR Wahoo	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
AV Garnet	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7
AV Jade	5	4.8	5	4.8	5	4.8	5	4.8	5	4.8	5	4.8	5	4.8	5	4.8	5	4.8	5	4.8	5	4.8	5
AV Zircon	7	6.8	7	7.7	7	7.7	7	7.7	7	7.7	7	7.7	7	7.7	7	7.7	7	7.7	7	7.7	7	7.7	7
Monola 515TT	5.8	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
Line A	6.2	6.8	6.4	6.2	6.4	6.2	6.4	6.2	6.4	6.2	6.4	6.2	6.4	6.2	6.4	6.2	6.4	6.2	6.4	6.2	6.4	6.2	6.4
Line B	6.3	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
Line C	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
B0050-027-18-20	5.7	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
Line D	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
Line E	5	5.8	5.4	5.5	5.4	5.5	5.4	5.5	5.4	5.5	5.4	5.5	5.4	5.5	5.4	5.5	5.4	5.5	5.4	5.5	5.4	5.5	5.4
Line F																							
DK7444																							
LL130																							
Min Cultivar Value	5	4.8	5	4.8	5	4.8	5	4.8	5	4.8	5	4.8	5	4.8	5	4.8	5	4.8	5	4.8	5	4.8	5
B0050-027-18-20	5.7	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
Max Cultivar Value	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7
Mean	6.1	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3
VAR	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
SE	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
LSD	0.31	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29
CV%	2.5	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3
Analysis	REML	REML	REML	REML	REML	REML	REML	REML	REML	REML	REML	REML	REML	REML	REML	REML	REML	REML	REML	REML	REML	REML	REML
F pr	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig


**Table 30.** Site by line treatment mean blackleg disease symptom score (1-9). Single plot data only.

Line name	Site	Across site mean						Coahurst		Vangaurd	
		NAR Blackleg Disease Symptom Score	NARBL Blackleg Disease Symptom Score	GYM Blackleg Disease Symptom Score	TOO Blackleg Disease Symptom Score	ARA Blackleg Disease Symptom Score	Across site mean Blackleg Disease Symptom Score	Blackleg Disease Resistance Score	Blackleg Disease Symptom Score	Alternaria Disease Symptom Score	
Trait	Unit	(1-9)	(1-9)	(1-9)	(1-9)	(1-9)	(1-9)	(1-9)	(1-9)	(1-9)	
ATR Bonito		3	2	1	1	2	1.8	6.0	2.0		
ATR											
Gem		3	2	1	2	2	2	5.9	3.0		
ATR Stingray		1	1	3	1	2	1.6	7.4	2.8		
ATR Wahoo		2	1	1	2	2	1.6	6.6	2.5		
AV											
Garnet		2	2	2	1	2	1.8	6.6	3.0		
AV Jade		3	1	2	2	2	2	7.4	1.8		
AV											
Zircon		2	1	1	2	2	1.6	7.4	1.0		
Monola 515TT		1	1	2	1	2	1.4	6.5	2.5		
Line A		1	1	1	1	2	1.2				
Line B		1				2	1.5				
Line C		2	1	1	1	2	1.4				
B0050-027-18-20		1	1	1	1.5	3	1.5	7.8	2.2		
Line D		1	1	1	2	2	1.4				
Line E		2	2	2	3	2	2.2				
Line F											
DK7444								8.5	1.8		
LL130								7.3	2.2		
								7.4	2.4		
Min Cultivar Value		1	1	1	1	2	1.4	5.9	1.0		
B0050-027-18-20		1	1	1	1.5	3	1.5	7.8-8.5	1.8-2.2		
Max Cultivar Value		3	2	3	2	2	2	7.4	3.0		
Mean								6.84	2.34		
VAR								0.45	0.21		
SE								0.67	0.45		
LSD								1.33	0.91		
CV%								9.8	19.42		
Analysis								REML	REML		
F pr								0.011	0.007		
								Sig	Sig		

**Table 31.** Site by line treatment mean lab seed moisture (%) post-harvest.

Year	2015																2015 Across site mean Lab Seed Moisture %
	NAR		NARBL		GYM		TOO		DOU		GRN		KAN		ARA		
	Lab	Seed	Lab	Seed	Lab	Seed	Lab	Seed	Lab	Seed	Lab	Seed	Lab	Seed	Lab	Seed	
Trait	Moisture		Moisture		Moisture		Moisture		Moisture		Moisture		Moisture		Moisture		Moisture
Unit	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	
ATR Bonito	7.2		6.5		6.4		6.9		6.7		6.3		6.3		6.8		6.6
ATR Gem	7.2		6.5		6.4		6.9		6.6		6.5		6.5		6.9		6.7
ATR Stingray	7.1		6.3		6.3		6.8		6.5		6.5		6.4		6.7		6.6
ATR Wahoo	7.3		6.5		6.3		6.7		6.5		6.5		6.4		7.0		6.7
AV Garnet	7.5		6.7		6.7		7.2		7.0		6.7		6.8		7.4		7.0
AV Jade	7.1		6.5		6.4		6.9		6.7		6.6		6.5		6.8		6.7
AV Zircon	7.0		6.4		6.3		6.9		6.6		6.5		6.5		6.9		6.6
Monola 515TT	7.4		6.7		6.6		7.2		6.9		6.6		6.6		7.0		6.9
B0050-027-18-20	7.5		6.7		6.7		7.1		6.7		6.4		6.5		7.1		6.8
Min Cultivar Value	7.0		6.3		6.3		6.7		6.5		6.3		6.3		6.7		6.6
B0050-027-18-20	7.5		6.7		6.7		7.1		6.7		6.4		6.5		7.1		6.8
Max Cultivar Value	7.5		6.7		6.7		7.2		7.0		6.7		6.8		7.4		7.0

**Table 32.** Site by line treatment mean seed oil % as measured using NMR.





## VI. REFERENCES

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## VII. APPENDICES

APPENDIX 1. SUMMARY STATISTICS FOR TRAITS MEASURED (ACROSS SITE) IN AUSTRALIA.  
Sorted from lowest to highest mean value. The DHA candidate is shaded in green, cultivars are shaded in yellow.

Trait Type	Trait Name	Line Type	Line name	MEAN	MEDIAN	MIN	MAX	RANGE	SD	SEM	VAR	SEVAR	%CV
Field	Blackleg Score	Cultivar	ATR Stingray	1.2	1.0	1.0	2.0	1.0	0.4	0.2	0.2	0.1	35.0
Field	Blackleg Score	Cultivar	Monola 515TT	1.3	1.0	1.0	2.0	1.0	0.5	0.2	0.3	0.1	38.7
Field	Blackleg Score	Candidate	B0050-027-18-20	1.4	1.0	1.0	3.0	2.0	0.7	0.2	0.5	0.2	50.3
Field	Blackleg Score	Cultivar	AV GARNET	1.5	1.5	1.0	2.0	1.0	0.5	0.2	0.3	0.1	36.5
Field	Blackleg Score	Cultivar	AV ZIRCON	1.7	2.0	1.0	2.0	1.0	0.5	0.2	0.3	0.1	31.0
Field	Blackleg Score	Cultivar	ATR Bonito	1.8	2.0	1.0	3.0	2.0	0.8	0.3	0.6	0.2	41.1
Field	Blackleg Score	Cultivar	ATR GEM	1.8	2.0	1.0	3.0	2.0	0.8	0.3	0.6	0.2	41.1
Field	Blackleg Score	Cultivar	ATR WAHOO	1.8	2.0	1.0	3.0	2.0	0.8	0.3	0.6	0.2	41.1
Field	Blackleg Score	Cultivar	AV JADE	1.8	2.0	1.0	3.0	2.0	0.8	0.3	0.6	0.2	41.1
	Blackleg Score	AVERAGE		1.6	1.6	1.0	2.6	1.6	0.6	0.3	0.4	0.2	39.5
Trait Type	Trait Name	Line Type	Line name	MEAN	MEDIAN	MIN	MAX	RANGE	SD	SEM	VAR	SEVAR	%CV
Field	Early Plant Count (No.)	Cultivar	AV JADE	7.9	8.0	1.5	14.5	13.0	2.8	0.5	8.1	1.7	36.2
Field	Early Plant Count (No.)	Cultivar	ATR WAHOO	11.0	10.0	5.0	19.0	14.0	3.8	0.6	14.3	2.6	34.5
Field	Early Plant Count (No.)	Cultivar	ATR Stingray	17.8	17.5	11.5	29.0	17.5	3.1	0.5	9.8	3.3	17.7
Field	Early Plant Count (No.)	Cultivar	ATR Bonito	17.9	18.0	10.5	25.0	14.5	3.2	0.5	10.1	2.0	17.7
Field	Early Plant Count (No.)	Candidate	B0050-027-18-20	18.0	18.0	11.0	25.0	14.0	3.6	0.4	13.1	1.7	20.1
Field	Early Plant Count (No.)	Cultivar	ATR GEM	18.3	17.8	11.0	30.0	19.0	4.1	0.6	16.6	3.8	22.3
Field	Early Plant Count (No.)	Cultivar	AV ZIRCON	19.0	18.8	10.5	30.5	20.0	4.3	0.7	18.2	4.1	22.5
Field	Early Plant Count (No.)	Cultivar	AV GARNET	19.3	19.3	13.0	29.0	16.0	3.9	0.6	15.5	3.1	20.4
Field	Early Plant Count (No.)	Cultivar	Monola 515TT	20.4	20.5	13.0	28.5	15.5	3.7	0.6	14.0	3.0	18.4
	Early Plant Count (No.)	Average		16.6	16.4	9.7	25.6	15.9	3.6	0.6	13.3	2.8	23.3
Trait Type	Trait Name	Line Type	Line name	MEAN	MEDIAN	MIN	MAX	RANGE	SD	SEM	VAR	SEVAR	%CV
Field	Emergence Score	Cultivar	AV JADE	5.1	5.0	2.0	7.0	5.0	1.3	0.2	1.6	0.4	25.0
Field	Emergence Score	Cultivar	ATR WAHOO	6.0	6.0	3.0	8.0	5.0	1.0	0.2	1.0	0.3	16.6
Field	Emergence Score	Cultivar	ATR GEM	7.3	7.0	5.0	8.0	3.0	0.7	0.1	0.5	0.2	9.8
Field	Emergence Score	Candidate	B0050-027-18-20	7.3	7.0	6.0	8.0	2.0	0.6	0.1	0.3	0.0	8.1
Field	Emergence Score	Cultivar	ATR Stingray	7.3	7.0	6.0	8.0	2.0	0.6	0.1	0.4	0.1	8.9
Field	Emergence Score	Cultivar	AV ZIRCON	7.4	8.0	6.0	8.0	2.0	0.7	0.1	0.5	0.1	9.6
Field	Emergence Score	Cultivar	ATR Bonito	7.5	8.0	6.0	8.0	2.0	0.6	0.1	0.4	0.1	8.0
Field	Emergence Score	Cultivar	AV GARNET	7.6	8.0	6.0	8.0	2.0	0.6	0.1	0.4	0.1	7.9
Field	Emergence Score	Cultivar	Monola 515TT	7.7	8.0	6.0	8.0	2.0	0.5	0.1	0.3	0.1	6.7

Emergence Score		Average										
Trait Type	Trait Name	Line Type	7.0	7.1	5.1	7.9	2.8	0.7	0.1	0.6	0.1	11.2
Field	Flowering 50% (Day)	Cultivar	100.8	100.5	95.0	110.0	15.0	4.2	0.7	17.8	2.7	4.2
Field	Flowering 50% (Day)	Cultivar	103.7	104.0	97.0	110.0	13.0	3.8	0.6	14.6	2.2	3.7
Field	Flowering 50% (Day)	Cultivar	104.3	105.0	99.0	109.0	10.0	3.7	0.6	14.0	1.6	3.6
Field	Flowering 50% (Day)	Cultivar	104.5	105.0	99.0	110.0	11.0	3.7	0.6	13.7	1.6	3.5
Field	Flowering 50% (Day)	Cultivar	105.4	106.5	99.0	113.0	14.0	4.0	0.6	16.3	2.3	3.8
Field	Flowering 50% (Day)	Cultivar	106.8	107.5	100.0	114.0	14.0	4.5	0.7	20.7	2.8	4.3
Field	Flowering 50% (Day)	Candidate	107.9	108.0	102.0	115.0	13.0	4.0	0.5	15.7	1.5	3.7
Field	Flowering 50% (Day)	Cultivar	108.6	109.5	101.0	115.0	14.0	4.5	0.7	20.4	2.4	4.2
Field	Flowering 50% (Day)	Cultivar	108.7	109.0	102.0	115.0	13.0	4.2	0.7	17.4	2.4	3.8
Field	Flowering 50% (Day)	Average	105.6	106.1	99.3	112.3	13.0	4.1	0.6	16.7	2.2	3.9
Field	Flowering Duration (Days)	Cultivar	26.6	28.0	19.0	32.0	13.0	4.0	0.6	16.0	2.6	15.1
Trait Type	Trait Name	Line Type	MEAN	MEDIAN	MIN	MAX	RANGE	SD	SEM	VAR	SEVAR	%CV
Field	Flowering Duration (Days)	Cultivar	27.1	28.0	22.0	32.0	10.0	2.7	0.4	7.6	1.1	10.2
Field	Flowering Duration (Days)	Candidate	27.4	27.5	22.0	33.0	11.0	2.4	0.3	5.7	0.9	8.7
Field	Flowering Duration (Days)	Cultivar	27.5	28.0	21.0	32.0	11.0	2.9	0.5	8.6	1.9	10.7
Field	Flowering Duration (Days)	Cultivar	27.6	28.0	22.0	31.0	9.0	2.5	0.4	6.4	1.5	9.2
Field	Flowering Duration (Days)	Cultivar	28.1	28.0	22.0	33.0	11.0	2.8	0.4	8.0	1.7	10.1
Field	Flowering Duration (Days)	Cultivar	28.4	28.0	23.0	34.0	11.0	2.4	0.4	5.7	1.2	8.4
Field	Flowering Duration (Days)	Cultivar	28.4	29.0	22.0	32.0	10.0	2.7	0.4	7.1	1.6	9.4
Field	Flowering Duration (Days)	Cultivar	29.2	30.0	22.0	32.0	10.0	2.8	0.4	7.7	1.8	9.5
Field	Flowering Duration (Days)	Average	27.8	28.3	21.7	32.3	10.7	2.8	0.4	8.1	1.6	10.1
Trait Type	Trait Name	Line Type	MEAN	MEDIAN	MIN	MAX	RANGE	SD	SEM	VAR	SEVAR	%CV
Field	Flowering End (Day)	Cultivar	129.9	130.5	124.0	138.0	14.0	3.9	0.6	15.4	2.2	3.0
Field	Flowering End (Day)	Cultivar	131.2	132.5	126.0	137.0	11.0	3.6	0.6	12.6	1.5	2.7
Field	Flowering End (Day)	Cultivar	132.0	132.0	127.0	140.0	13.0	3.6	0.6	12.7	2.1	2.7
Field	Flowering End (Day)	Cultivar	132.8	132.5	128.0	139.0	11.0	3.7	0.6	13.4	1.9	2.8
Field	Flowering End (Day)	Cultivar	133.5	133.0	129.0	141.0	12.0	3.6	0.6	12.7	2.3	2.7
Field	Flowering End (Day)	Cultivar	135.1	136.0	130.0	141.0	11.0	3.7	0.6	13.5	1.7	2.7
Field	Flowering End (Day)	Cultivar	135.2	135.0	127.0	142.0	15.0	4.0	0.6	16.2	3.1	3.0
Field	Flowering End (Day)	Candidate	135.3	137.0	128.0	144.0	16.0	4.5	0.5	20.6	2.0	3.4
Field	Flowering End (Day)	Cultivar	135.7	135.5	128.0	143.0	15.0	4.1	0.6	16.8	2.7	3.0
Field	Flowering End (Day)	Average	133.4	133.8	127.4	140.6	13.1	3.8	0.6	14.9	2.2	2.9
Trait Type	Trait Name	Line Type	MEAN	MEDIAN	MIN	MAX	RANGE	SD	SEM	VAR	SEVAR	%CV
Field	Grain Moisture % at Harvest	Cultivar	8.2	8.1	5.8	14.5	8.7	1.8	0.3	3.1	1.0	21.5
Field	Grain Moisture % at Harvest	Cultivar	9.7	9.6	7.4	12.8	5.4	1.3	0.2	1.8	0.3	13.6
Field	Grain Moisture % at Harvest	Cultivar	9.8	9.5	7.7	16.8	9.1	1.7	0.3	2.9	1.2	17.3

Field	Grain Moisture % at Harvest	Cultivar	AV GARNET	10.4	10.3	8.4	14.6	6.2	1.4	0.2	1.9	0.5	13.2
Field	Grain Moisture % at Harvest	Cultivar	ATR Bonito	10.4	10.7	8.0	15.1	7.1	1.6	0.2	2.4	0.6	14.9
Field	Grain Moisture % at Harvest	Candidate	B0050-027-18-20	10.9	10.8	8.1	15.2	7.1	1.4	0.2	2.0	0.4	13.0
Field	Grain Moisture % at Harvest	Cultivar	Monola 515TT	12.1	11.9	8.0	18.5	10.5	3.0	0.5	9.3	1.5	25.2
Field	Grain Moisture % at Harvest	Cultivar	ATR GEM	12.6	12.1	7.8	20.7	12.9	3.0	0.5	8.8	1.8	23.6
Field	Grain Moisture % at Harvest	Cultivar	ATR WAHOO	16.9	18.8	8.5	23.9	15.4	5.2	0.8	26.8	2.8	30.6
	<b>Grain Moisture % at Harvest</b>	<b>Average</b>		<b>11.2</b>	<b>11.3</b>	<b>7.7</b>	<b>16.9</b>	<b>9.2</b>	<b>2.3</b>	<b>0.4</b>	<b>6.6</b>	<b>1.1</b>	<b>19.2</b>
<b>Trait Type</b>	<b>Trait Name</b>	<b>Line Type</b>	<b>Line name</b>	<b>MEAN</b>	<b>MEDIAN</b>	<b>MIN</b>	<b>MAX</b>	<b>RANGE</b>	<b>SD</b>	<b>SEM</b>	<b>VAR</b>	<b>SEVAR</b>	<b>%CV</b>
Field	Lodging Score	Candidate	B0050-027-18-20	1.0	1.0	1.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0
Field	Lodging Score	Cultivar	ATR GEM	1.0	1.0	1.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0
Field	Lodging Score	Cultivar	ATR Stingray	1.0	1.0	1.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0
Field	Lodging Score	Cultivar	ATR WAHOO	1.0	1.0	1.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0
Field	Lodging Score	Cultivar	AV GARNET	1.0	1.0	1.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0
Field	Lodging Score	Cultivar	AV ZIRCON	1.0	1.0	1.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0
Field	Lodging Score	Cultivar	Monola 515TT	1.0	1.0	1.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0
Field	Lodging Score	Cultivar	ATR Bonito	1.2	1.0	1.0	2.0	1.0	0.4	0.2	0.2	0.1	37.3
Field	Lodging Score	Cultivar	AV JADE	1.2	1.0	1.0	2.0	1.0	0.4	0.2	0.2	0.1	37.3
	<b>Lodging Score</b>	<b>Average</b>		<b>1.0</b>	<b>1.0</b>	<b>1.0</b>	<b>1.2</b>	<b>0.2</b>	<b>0.1</b>	<b>0.0</b>	<b>0.0</b>	<b>0.0</b>	<b>8.3</b>
<b>Trait Type</b>	<b>Trait Name</b>	<b>Line Type</b>	<b>Line name</b>	<b>MEAN</b>	<b>MEDIAN</b>	<b>MIN</b>	<b>MAX</b>	<b>RANGE</b>	<b>SD</b>	<b>SEM</b>	<b>VAR</b>	<b>SEVAR</b>	<b>%CV</b>
Field	Plant Height (cm)	Cultivar	ATR Stingray	82.7	85.0	57.0	104.0	47.0	14.4	2.3	208.3	28.1	17.4
Field	Plant Height (cm)	Cultivar	Monola 515TT	86.9	91.5	54.0	108.0	54.0	15.2	2.4	231.5	44.4	17.5
Field	Plant Height (cm)	Cultivar	Monola 515TT	86.9	91.5	54.0	108.0	54.0	15.2	2.4	231.5	44.4	17.5
Field	Plant Height (cm)	Cultivar	Monola 515TT	86.9	91.5	54.0	108.0	54.0	15.2	2.4	231.5	44.4	17.5
Field	Plant Height (cm)	Candidate	B0050-027-18-20	89.6	91.0	60.0	112.0	52.0	15.0	1.8	224.5	29.7	16.7
Field	Plant Height (cm)	Cultivar	AV JADE	89.9	90.0	63.0	110.0	47.0	14.3	2.3	204.0	30.5	15.9
Field	Plant Height (cm)	Cultivar	ATR Bonito	90.0	95.0	58.0	110.0	52.0	15.7	2.5	246.7	42.9	17.5
Field	Plant Height (cm)	Cultivar	ATR GEM	90.3	93.5	56.0	115.0	59.0	17.1	2.7	293.9	47.4	19.0
Field	Plant Height (cm)	Cultivar	ATR WAHOO	91.7	95.0	42.0	115.0	73.0	16.1	2.5	259.2	66.8	17.6
Field	Plant Height (cm)	Cultivar	AV ZIRCON	99.1	100.0	68.0	128.0	60.0	17.9	2.8	319.7	51.1	18.0
Field	Plant Height (cm)	Cultivar	AV GARNET	102.7	105.0	68.0	129.0	61.0	18.9	3.0	357.2	56.5	18.4
	<b>Plant Height (cm)</b>	<b>Average</b>		<b>90.6</b>	<b>93.5</b>	<b>57.6</b>	<b>113.4</b>	<b>55.7</b>	<b>15.9</b>	<b>2.5</b>	<b>255.3</b>	<b>44.2</b>	<b>17.6</b>
<b>Trait Type</b>	<b>Trait Name</b>	<b>Line Type</b>	<b>Line name</b>	<b>MEAN</b>	<b>MEDIAN</b>	<b>MIN</b>	<b>MAX</b>	<b>RANGE</b>	<b>SD</b>	<b>SEM</b>	<b>VAR</b>	<b>SEVAR</b>	<b>%CV</b>
Field	Post Harvest Plant Count (No.)	Cultivar	ATR WAHOO	11.9	11.0	5.5	21.0	15.5	3.6	0.6	12.8	2.7	30.1
Field	Post Harvest Plant Count (No.)	Cultivar	AV JADE	12.1	12.5	4.5	20.5	16.0	3.8	0.6	14.1	2.8	31.1
Field	Post Harvest Plant Count (No.)	Candidate	B0050-027-18-20	15.1	15.0	7.0	23.0	16.0	3.1	0.4	9.8	1.6	20.8
Field	Post Harvest Plant Count (No.)	Cultivar	AV ZIRCON	15.4	15.0	9.5	26.5	17.0	3.3	0.6	11.1	3.8	21.6
Field	Post Harvest Plant Count (No.)	Cultivar	ATR Bonito	15.8	15.5	10.5	22.0	11.5	3.1	0.5	9.8	1.7	19.9
Field	Post Harvest Plant Count (No.)	Cultivar	AV GARNET	16.2	16.5	9.5	24.5	15.0	4.0	0.7	15.7	3.1	24.4

Field	Post Harvest Plant Count (No.)	Cultivar	ATR GEM	16.6	16.0	10.0	29.5	19.5	4.6	0.8	21.2	5.2	27.8
Field	Post Harvest Plant Count (No.)	Cultivar	ATR Stingray	17.4	16.5	9.0	24.0	15.0	4.2	0.7	17.6	3.1	24.1
Field	Post Harvest Plant Count (No.)	Cultivar	Monola 515TT	18.6	19.0	9.0	26.0	17.0	3.8	0.6	14.2	3.2	20.3
<b>Post Harvest Plant Count</b>													
	<b>(No.)</b>	<b>Average</b>		<b>15.4</b>	<b>15.2</b>	<b>8.3</b>	<b>24.1</b>	<b>15.8</b>	<b>3.7</b>	<b>0.6</b>	<b>14.0</b>	<b>3.0</b>	<b>24.5</b>
<b>Trait Type</b>	<b>Trait Name</b>	<b>Line Type</b>	<b>Line name</b>	<b>MEAN</b>	<b>MEDIAN</b>	<b>MIN</b>	<b>MAX</b>	<b>RANGE</b>	<b>SD</b>	<b>SEM</b>	<b>VAR</b>	<b>SEVAR</b>	<b>%CV</b>
Field	Shattering Score	Cultivar	ATR GEM	1.8	1.0	1.0	6.0	5.0	1.5	0.5	2.4	1.5	84.6
Field	Shattering Score	Cultivar	ATR Bonito	1.9	1.0	1.0	5.0	4.0	1.4	0.4	1.9	0.8	72.0
Field	Shattering Score	Cultivar	ATR Stingray	1.9	1.0	1.0	4.0	3.0	1.2	0.4	1.5	0.4	64.0
Field	Shattering Score	Cultivar	AV JADE	2.0	1.0	1.0	5.0	4.0	1.4	0.4	2.0	0.8	70.7
Field	Shattering Score	Candidate	B0050-027-18-20	2.2	1.5	1.0	5.0	4.0	1.3	0.3	1.8	0.4	62.7
Field	Shattering Score	Cultivar	Monola 515TT	2.2	1.0	1.0	5.0	4.0	1.5	0.5	2.4	0.6	70.5
Field	Shattering Score	Cultivar	AV GARNET	2.4	1.0	1.0	6.0	5.0	1.9	0.6	3.5	1.1	78.6
Field	Shattering Score	Cultivar	ATR WAHOO	2.8	1.0	1.0	7.0	6.0	2.5	0.7	6.2	1.7	88.1
Field	Shattering Score	Cultivar	AV ZIRCON	3.0	1.0	1.0	7.0	6.0	2.5	0.8	6.4	1.4	84.3
<b>Shattering Score</b>				<b>2.2</b>	<b>1.1</b>	<b>1.0</b>	<b>5.6</b>	<b>4.6</b>	<b>1.7</b>	<b>0.5</b>	<b>3.1</b>	<b>1.0</b>	<b>75.1</b>
<b>Trait Type</b>	<b>Trait Name</b>	<b>Line Type</b>	<b>Line name</b>	<b>MEAN</b>	<b>MEDIAN</b>	<b>MIN</b>	<b>MAX</b>	<b>RANGE</b>	<b>SD</b>	<b>SEM</b>	<b>VAR</b>	<b>SEVAR</b>	<b>%CV</b>
Field	Shattering Seeds	Cultivar	ATR Bonito	7.7	4.3	0.0	41.5	41.5	9.6	1.6	92.7	32.3	124.5
Field	Shattering Seeds	Cultivar	AV JADE	8.8	3.0	0.0	70.0	70.0	15.1	2.6	227.9	115.4	172.4
Field	Shattering Seeds	Candidate	B0050-027-18-20	10.1	6.8	0.0	45.5	45.5	10.2	1.3	104.6	24.0	101.6
Field	Shattering Seeds	Cultivar	ATR GEM	10.3	5.8	0.0	50.0	50.0	12.9	2.2	167.5	47.8	125.4
Field	Shattering Seeds	Cultivar	ATR WAHOO	11.2	5.0	0.0	60.0	60.0	15.6	2.5	242.3	76.3	138.5
Field	Shattering Seeds	Cultivar	ATR Stingray	12.3	7.3	0.0	58.0	58.0	13.5	2.3	183.6	61.8	110.0
Field	Shattering Seeds	Cultivar	Monola 515TT	13.4	6.0	0.0	67.5	67.5	17.7	2.9	311.8	116.5	131.6
Field	Shattering Seeds	Cultivar	AV GARNET	18.4	12.0	0.0	100.0	100.0	22.6	3.8	510.7	224.2	123.0
Field	Shattering Seeds	Cultivar	AV ZIRCON	22.1	15.8	0.0	105.0	105.0	22.9	3.7	523.1	187.4	103.6
<b>Shattering Seeds</b>				<b>12.7</b>	<b>7.3</b>	<b>0.0</b>	<b>66.4</b>	<b>66.4</b>	<b>15.6</b>	<b>2.5</b>	<b>262.7</b>	<b>98.4</b>	<b>125.6</b>
<b>Trait Type</b>	<b>Trait Name</b>	<b>Line Type</b>	<b>Line name</b>	<b>MEAN</b>	<b>MEDIAN</b>	<b>MIN</b>	<b>MAX</b>	<b>RANGE</b>	<b>SD</b>	<b>SEM</b>	<b>VAR</b>	<b>SEVAR</b>	<b>%CV</b>
Field	Vigour Score	Cultivar	AV JADE	4.7	5.0	3.0	7.0	4.0	0.8	0.1	0.6	0.2	17.3
Field	Vigour Score	Cultivar	ATR Stingray	5.7	6.0	5.0	7.0	2.0	0.5	0.1	0.3	0.0	8.8
Field	Vigour Score	Cultivar	Monola 515TT	5.8	6.0	5.0	7.0	2.0	0.6	0.1	0.3	0.1	10.2
Field	Vigour Score	Candidate	B0050-027-18-20	5.8	6.0	4.0	7.0	3.0	0.6	0.1	0.4	0.1	10.3
Field	Vigour Score	Cultivar	ATR WAHOO	6.0	6.0	5.0	7.0	2.0	0.6	0.1	0.4	0.1	10.7
Field	Vigour Score	Cultivar	ATR GEM	6.5	7.0	4.0	8.0	4.0	0.8	0.1	0.7	0.2	12.6
Field	Vigour Score	Cultivar	ATR Bonito	6.6	7.0	5.0	8.0	3.0	0.6	0.1	0.3	0.1	8.9
Field	Vigour Score	Cultivar	AV ZIRCON	7.0	7.0	5.0	8.0	3.0	0.7	0.1	0.4	0.1	9.5
Field	Vigour Score	Cultivar	AV GARNET	7.1	7.0	5.0	8.0	3.0	0.7	0.1	0.5	0.1	9.5
<b>Vigour Score</b>				<b>6.1</b>	<b>6.3</b>	<b>4.6</b>	<b>7.4</b>	<b>2.9</b>	<b>0.7</b>	<b>0.1</b>	<b>0.4</b>	<b>0.1</b>	<b>10.9</b>

Trait Type	Trait Name	Line Type	Line name	MEAN	MEDIAN	MIN	MAX	RANGE	SD	SEM	VAR	SEVAR	%CV
Lab	Moisture % (Lab)	Cultivar	ATR Stingray	6.5	6.4	6.1	7.6	1.5	0.3	0.1	0.1	0.0	5.3
Lab	Moisture % (Lab)	Cultivar	ATR Bonito	6.6	6.7	5.9	7.6	1.8	0.4	0.1	0.1	0.0	5.6
Lab	Moisture % (Lab)	Cultivar	AV JADE	6.6	6.6	6.0	7.4	1.4	0.3	0.1	0.1	0.0	4.7
Lab	Moisture % (Lab)	Cultivar	AV ZIRCON	6.7	6.6	6.2	7.3	1.1	0.3	0.0	0.1	0.0	4.4
Lab	Moisture % (Lab)	Cultivar	ATR GEM	6.7	6.6	6.1	7.6	1.6	0.4	0.1	0.1	0.0	5.7
Lab	Moisture % (Lab)	Cultivar	ATR WAHOO	6.7	6.7	6.1	7.9	1.8	0.4	0.1	0.2	0.0	6.0
Lab	Moisture % (Lab)	Candidate	B0050-027-18-20	6.8	6.8	6.2	8.0	1.8	0.4	0.0	0.2	0.0	6.0
Lab	Moisture % (Lab)	Cultivar	Monola 515TT	6.9	6.8	6.3	7.8	1.5	0.4	0.1	0.1	0.0	5.5
Lab	Moisture % (Lab)	Cultivar	AV GARNET	7.0	7.0	6.2	7.9	1.6	0.4	0.1	0.1	0.0	5.2
Moisture % (Lab)		Average		6.7	6.7	6.1	7.7	1.6	0.4	0.1	0.1	0.0	5.4

**APPENDIX 2. STUDENT T-TEST THAT THE MEAN OF B0050-027-18-20 IS SIGNIFICANTLY DIFFERENT TO SPECIFIC CULTIVAR MEANS FOR AGRONOMIC TRAITS, BASED ON ACROSS SITE DATA IN AUSTRALIA. (DEGREES OF FREEDOM= 109)**

Line	Measure	Early plant No.	Post harvest plant No.	Emergence score	Blackleg score	Vigour score
B0050-027-18-20	Mean	18.0	15.1	7.3	1.4	5.8
ATR Bonito	Mean	17.9	15.8	7.5	1.8	6.6
ATR GEM	Mean	18.3	16.6	7.3	1.8	6.5
ATR Stingray	Mean	17.8	17.4	7.3	1.2	5.7
ATR WAHOO	Mean	11.0	11.9	6.0	1.8	6.0
AV GARNET	Mean	19.3	16.2	7.6	1.5	7.1
AV JADE	Mean	7.9	12.1	5.1	1.8	4.7
AV ZIRCON	Mean	19.0	15.4	7.4	1.7	7.0
Monola 515TT	Mean	20.4	18.6	7.7	1.3	5.8
ATR Bonito vs B0050-027-18-20	T Test probability	0.882847897	0.291146464	0.042003391	0.342431318	8.0973E-09
ATR GEM vs B0050-027-18-20	T Test probability	0.770013398	0.088166682	0.960047781	0.342431318	6.6395E-05
ATR Stingray vs B0050-027-18-20	T Test probability	0.678614386	0.005668675	0.883157108	0.362221215	0.26540965
ATR WAHOO vs B0050-027-18-20	T Test probability	6.89629E-15	4.04317E-05	1.41464E-09	0.342431318	0.39862173
AV GARNET vs B0050-027-18-20	T Test probability	0.089417365	0.135704684	0.025081748	0.868806703	5.2054E-15
AV JADE vs B0050-027-18-20	T Test probability	1.10271E-29	0.000166044	6.1037E-14	0.342431318	1.3642E-11
AV ZIRCON vs B0050-027-18-20	T Test probability	0.225983992	0.647009294	0.373776813	0.501142244	1.9515E-13
Monola 515TT vs B0050-027-18-20	T Test probability	0.001882344	1.78682E-05	0.000192069	0.734880955	0.41972635
ATR Bonito vs B0050-027-18-20	T Value	0.1	1.1	2.1	1.0	6.3
ATR GEM vs B0050-027-18-20	T Value	0.3	1.7	0.1	1.0	4.1
ATR Stingray vs B0050-027-18-20	T Value	0.4	2.8	0.1	0.9	1.1
ATR WAHOO vs B0050-027-18-20	T Value	9.0	4.3	6.6	1.0	0.8
AV GARNET vs B0050-027-18-20	T Value	1.7	1.5	2.3	0.2	9.1
AV JADE vs B0050-027-18-20	T Value	15.7	3.9	8.6	1.0	7.6
AV ZIRCON vs B0050-027-18-20	T Value	1.2	0.5	0.9	0.7	8.4
Monola 515TT vs B0050-027-18-20	T Value	3.2	4.5	3.9	0.3	0.8

Con't

Line		Measure	Flowering Day	Flowering End Day	Flowering Days	Plant height (cm)	Shattering Seeds
B0050-027-18-20	ATR Bonito ATR GEM ATR Stingray ATR WAHOO AV GARNET AV JADE AV ZIRCON Monola 515TT	Mean	107.9	135.3	27.4	89.6	10.1
		Mean	103.7	131.2	27.5	90.0	7.7
		Mean	105.4	133.5	28.1	90.3	10.3
		Mean	100.8	129.9	29.2	82.7	12.3
		Mean	108.6	135.7	27.1	91.7	11.2
		Mean	104.3	132.8	28.4	102.7	18.4
		Mean	106.8	135.1	28.4	89.9	8.8
		Mean	104.5	132.0	27.6	99.1	22.1
		Mean	108.7	135.2	26.6	86.9	13.4
		Mean	103.7	131.2	27.5	90.0	7.7
ATR Bonito vs B0050-027-18-20	ATR GEM vs B0050-027-18-20 ATR Stingray vs B0050-027-18-20 ATR WAHOO vs B0050-027-18-20 AV GARNET vs B0050-027-18-20 AV JADE vs B0050-027-18-20 AV ZIRCON vs B0050-027-18-20 Monola 515TT vs B0050-027-18-20	T Test probability	6.06319E-07	8.80565E-07	0.87035722	0.90324465	0.251090997
		T Test probability	0.002445462	0.023350085	0.16819286	0.830245724	0.921191568
		T Test probability	4.36434E-13	3.64445E-09	0.00106635	0.020155863	0.389711695
		T Test probability	0.404960455	0.679655211	0.55220599	0.496334641	0.681817398
		T Test probability	1.07934E-05	0.001763106	0.04499676	0.000360619	0.045588465
		T Test probability	0.211234008	0.826123982	0.04519077	0.910930932	0.647423708
		T Test probability	1.85607E-05	5.40298E-05	0.73858322	0.005845101	0.003722802
		T Test probability	0.331695661	0.905069179	0.23364294	0.364646051	0.29036982
		T Value	5.3	5.2	0.2	0.1	1.2
		T Value	3.1	2.3	1.4	0.2	0.1
ATR Bonito vs B0050-027-18-20	ATR Stingray vs B0050-027-18-20 ATR WAHOO vs B0050-027-18-20 AV GARNET vs B0050-027-18-20 AV JADE vs B0050-027-18-20 AV ZIRCON vs B0050-027-18-20 Monola 515TT vs B0050-027-18-20	T Value	8.2	6.4	3.4	2.4	0.9
		T Value	0.8	0.4	0.6	0.7	0.4
		T Value	4.6	3.2	2.0	3.7	2.0
		T Value	1.3	0.2	2.0	0.1	0.5
		T Value	4.5	4.2	0.3	2.8	3.0
		T Value	1.0	0.1	1.2	0.9	1.1
		T Value	3.1	2.3	1.4	0.2	0.1
		T Value	8.2	6.4	3.4	2.4	0.9
		T Value	0.8	0.4	0.6	0.7	0.4
		T Value	4.6	3.2	2.0	3.7	2.0



Con't

Line	Measure	Shattering Seeds	Shattering Score 1-9	Lodging score 1-9	Grain moisture % at Harvest
B0050-027-18-20	Mean	10.1	2.2	1.0	10.9
ATR Bonito	Mean	7.7	1.9	n.s	10.4
ATR GEM	Mean	10.3	1.8	n.s	12.6
ATR Stingray	Mean	12.3	1.9	n.s	8.2
ATR WAHOO	Mean	11.2	2.8	n.s	16.9
AV GARNET	Mean	18.4	2.4	Sig	10.4
AV JADE	Mean	8.8	2.0	n.s	9.8
AV ZIRCON	Mean	22.1	3.0	Sig	9.7
Monola 515TT	Mean	13.4	2.2	n.s	12.1
ATR Bonito vs B0050-027-18-20	T Test probability	0.251090997	0.643403713	0.373900966	0.103168575
ATR GEM vs B0050-027-18-20	T Test probability	0.921191568	0.5557525		0.00162919
ATR Stingray vs B0050-027-18-20	T Test probability	0.389711695	0.617595303		5.33223E-12
ATR WAHOO vs B0050-027-18-20	T Test probability	0.681817398	0.422264771		7.72946E-09
AV GARNET vs B0050-027-18-20	T Test probability	0.045588465	0.74147199		0.071065566
AV JADE vs B0050-027-18-20	T Test probability	0.647423708	0.776914214	0.373900966	0.001013786
AV ZIRCON vs B0050-027-18-20	T Test probability	0.003722802	0.318663849		3.12193E-05
Monola 515TT vs B0050-027-18-20	T Test probability	0.29036982	0.954732859		0.022751588
ATR Bonito vs B0050-027-18-20	T Value	1.2	0.5	0.9	1.6
ATR GEM vs B0050-027-18-20	T Value	0.1	0.6		3.2
ATR Stingray vs B0050-027-18-20	T Value	0.9	0.5		7.7
ATR WAHOO vs B0050-027-18-20	T Value	0.4	0.8		6.3
AV GARNET vs B0050-027-18-20	T Value	2.0	0.3		1.8
AV JADE vs B0050-027-18-20	T Value	0.5	0.3	0.9	3.4
AV ZIRCON vs B0050-027-18-20	T Value	3.0	1.0		4.3
Monola 515TT vs B0050-027-18-20	T Value	1.1	0.1		2.3

APPENDIX 3. STUDENT T-TEST THAT THE MEAN OF B0050-027-18-20 IS SIGNIFICANTLY DIFFERENT TO SPECIFIC CULTIVAR MEANS FOR SEED TRAITS BASED ON ACROSS SITE DATA IN AUSTRALIA. (DEGREES OF FREEDOM= 109)

Line	Measure	% Moisture
B0050-027-18-20	Mean	6.8
ATR Bonito	Mean	6.6
ATR GEM	Mean	6.7
ATR Stingray	Mean	6.5
ATR WAHOO	Mean	6.7
AV GARNET	Mean	7.0
AV JADE	Mean	6.6
AV ZIRCON	Mean	6.7
Monola 515TT	Mean	6.9
ATR Bonito vs B0050-027-18-20	T Test probability	0.012714178
ATR GEM vs B0050-027-18-20	T Test probability	0.102739714
ATR Stingray vs B0050-027-18-20	T Test probability	0.000390568
ATR WAHOO vs B0050-027-18-20	T Test probability	0.303568016
AV GARNET vs B0050-027-18-20	T Test probability	0.005934648
AV JADE vs B0050-027-18-20	T Test probability	0.014254421
AV ZIRCON vs B0050-027-18-20	T Test probability	0.035584111
Monola 515TT vs B0050-027-18-20	T Test probability	0.487733739
ATR Bonito vs B0050-027-18-20	T Value	2.5
ATR GEM vs B0050-027-18-20	T Value	1.6
ATR Stingray vs B0050-027-18-20	T Value	3.7
ATR WAHOO vs B0050-027-18-20	T Value	1.0
AV GARNET vs B0050-027-18-20	T Value	2.8
AV JADE vs B0050-027-18-20	T Value	2.5
AV ZIRCON vs B0050-027-18-20	T Value	2.1
Monola 515TT vs B0050-027-18-20	T Value	0.7

#### APPENDIX 4. RAINFALL RECORDED PER SITE

Australia	Rainfall (mm)	Rainfall (mm)	Rainfall (mm)	Rainfall (mm)	Rainfall (mm)	Rainfall (mm)	Rainfall (mm)
Site	Jun	Jul	Aug	Sep	Oct	Nov	<sup>1</sup> Total for period of trial
1507_NARBL	16	16	16	4	25	14	90
1506_NAR	16	21	15	23	2	14	91
1508_DOU	47	14	15	26	2	20	122
1510_TOO	47	18	13	27	2	17	123
1513_KAN	29	39	13	25	0	27	133
1512_GYM	40	34	11	31	18	18	151
1509_GRN	43	11	8	36	33	22	152
1514_ARA	51	35	20	42	1	66	214

<sup>1</sup>Total taken from local weather station, and includes Total includes supplementary irrigation in Sep of 12.9mm and in Oct of 30.1mm

Canada	Rainfall (mm)	Rainfall (mm)	Rainfall (mm)	Rainfall (mm)	Rainfall (mm)	Rainfall (mm)
Site	May	Jun	Jul	Aug	Sep	Total for period of trial
CH	66.3	67.8	164.6	40.2	17.3	356.2
VG	124.5	83.8	91.4	200.7	NA	500.4

APPENDIX 5. SOIL TYPES.

Site	Soil type
1507_NARBL	Clay
1506_NAR	Clay
1508_DOU	Clay Loam
1510_TOO	Sandy Loam
1513_KAN	Clay
1512_GYM	Clay Loam
1509_GRN	Clay
1514_ARA	Clay Loam
CH	Sandy clay loam
VG	Clay loam

# APPENDIX 6. PLANTING AND HARVEST DATES.

Site	Sowing Date	Harvest Date
1510_TOO	1-Jun-15	23-Nov-15
1508_DOU	2-Jun-15	24-Nov-15
1506_NAR	3-Jun-15	18-Nov-15
1507_NARBL	3-Jun-15	18-Nov-15
1512_GYM	8-Jun-15	17-Nov-15
1513_KAN	9-Jun-15	4-Dec-15
1514_ARA	10-Jun-15	7-Dec-15
1509_GRN	11-Jun-15	1-Dec-15
Coalhurst, AB	17-May-16	15-Sep-16
Vanguard, SK	20-May-16	17-Sep-16

# APPENDIX 7. SUMMARY STATISTICS FOR AGRONOMIC TRAITS MEASURED (ACROSS BOTH SITES) IN CANADA.

	Early Vigor		Early Vigor		Early Vigor		Early Vigor		Early Vigor		Early Vigor		Early Vigor		Early Vigor	
	1-9		1-9		1-9		1-9		1-9		1-9		1-9		1-9	
	Nobservd		Mean		Minimum		Maximum		Variance		Median		s.d.			
Name																
ATR Bonito	10.0		5.5		3.0		9.0		3.9		5.0		2.0			
ATR GEM	10.0		5.2		3.0		8.5		4.2		4.8		2.1			
ATR Stingray	10.0		4.3		2.5		6.0		2.3		4.3		1.5			
ATR WAHOO	10.0		5.5		3.5		8.0		3.0		4.8		1.7			
AV Garnet	10.0		5.1		3.5		7.0		1.7		4.8		1.3			
AV Jade	9.0		5.9		3.5		9.0		5.6		4.5		2.4			
AV ZIRCON	10.0		4.1		3.0		6.0		1.2		3.5		1.1			
B0050-027-18-20	10.0		3.1		2.0		5.0		1.2		3.0		1.1			
B0050-027-18-20-12-19	10.0		5.1		3.0		9.0		4.4		4.5		2.1			
DK 7444 BL	10.0		6.3		4.0		9.0		4.3		6.3		2.1			
LL130	10.0		5.4		4.0		8.0		2.1		5.3		1.5			
Monola 515 TT	10.0		5.3		4.0		8.0		2.2		4.8		1.5			
	Flower Start		Flower Start		Flower Start		Flower Start		Flower Start		Flower Start		Flower Start		Flower Start	
	Day		Day		Day		Day		Day		Day		Day		Day	
	Nobservd		Mean		Minimum		Maximum		Variance		Median		s.d.			
Name																
ATR Bonito	10.0		48.8		45.0		52.0		9.3		48.5		3.0			
ATR GEM	10.0		48.3		45.0		52.0		7.6		48.0		2.8			
ATR Stingray	10.0		48.0		44.0		52.0		12.9		46.5		3.6			
ATR WAHOO	10.0		48.3		45.0		52.0		7.8		48.0		2.8			

AV Garnet	10.0	48.2	45.0	52.0	6.2	48.5	2.5
AV Jade	9.0	47.3	44.0	52.0	9.8	46.0	3.1
AV ZIRCON	10.0	49.9	48.0	52.0	2.3	49.0	1.5
B0050-027-18-20	10.0	49.3	47.0	52.0	3.3	49.5	1.8
B0050-027-18-20-12-19	10.0	49.4	46.0	52.0	6.3	49.5	2.5
DK 7444 BL	10.0	46.6	43.0	52.0	14.7	46.0	3.8
LL130	10.0	47.1	44.0	52.0	8.3	46.5	2.9
Monola 515 TT	10.0	46.7	44.0	50.0	7.6	46.5	2.8
	Flower End	Flower End	Flower End	Flower End	Flower End	Flower End	Flower End
	Day	Day	Day	Day	Day	Day	Day
	Nobservd	Mean	Minimum	Maximum	Variance	Median	s.d.
Name							
ATR Bonito	10.0	74.7	73.0	79.0	4.7	74.0	2.2
ATR GEM	10.0	75.8	73.0	79.0	3.5	76.0	1.9
ATR Stingray	10.0	74.2	71.0	79.0	5.3	73.5	2.3
ATR WAHOO	10.0	75.2	73.0	79.0	5.3	74.0	2.3
AV Garnet	10.0	76.2	73.0	79.0	6.2	75.0	2.5
AV Jade	9.0	76.0	74.0	79.0	4.3	75.0	2.1
AV ZIRCON	10.0	75.7	73.0	79.0	3.1	75.0	1.8
B0050-027-18-20	10.0	76.7	73.0	79.0	3.6	76.0	1.9
B0050-027-18-20-12-19	10.0	76.5	74.0	79.0	3.8	76.0	2.0
DK 7444 BL	10.0	72.6	71.0	79.0	5.6	72.0	2.4
LL130	10.0	72.3	71.0	74.0	1.1	72.5	1.1
Monola 515 TT	10.0	73.5	71.0	79.0	4.9	73.0	2.2
	Flower Duration	Flower Duration	Flower Duration	Flower Duration	Flower Duration	Flower Duration	Flower Duration





B0050-027-18-20	5.0	100.8	92.0	113.0	58.7	100.0	7.7
B0050-027-18-20-12-19	5.0	103.0	91.0	111.0	74.5	104.0	8.6
DK 7444 BL	5.0	112.8	110.0	118.0	10.7	113.0	3.3
LL130	5.0	120.6	117.0	125.0	8.3	120.0	2.9
Monola 515 TT	5.0	83.6	79.0	87.0	8.8	84.0	3.0

