

Analysis of Results Wind Tunnel Testing UQ Gatton Under Supervision of Dr Andrew Hewitt 22nd – 24th December 2021.

Introduction

Advanced Wetting Technologies Pty Ltd (AWT) has developed a proprietary technology to dramatically enhance the performance of the application of herbicides across all types of agricultural crop spraying. This performance is critical to the effectiveness of crop spraying in terms of the efficient and appropriate absorption of chemicals into the target crops as well as the optimisation of spraying area by controlling 'drift'. Both these factors have obviously become increasingly critical in all agricultural and other spraying applications. In order to confirm the efficacy of the AWT technology, a study was conducted in the straight through blower wind tunnel at The University of Queensland Gatton under the supervision of Dr Andrew Hewitt a world authority on spray drift to measure the emission droplet size spectra from nozzles with tank mixes for ground spray applications in Australia.

Methodology

Each tank mix was prepared with herbicide and adjuvant ingredients to produce tank mix compositions supplied by Bayer and AWT. Tap water, free of particulates was used as the carrier and each ingredient was added and mixed using stirring until uniform. The dynamic surface tension (DST) was measured at surface lifetime ages of 20 and 40 ms for each tank mix using a SITA DynoTester maximum bubble pressure surface tensiometer, within 5 minutes of the tank mix then being sprayed through the test system.

Following mixing and measurement of DST, each tank mix was placed in a pressurised stainless steel canister which was shaken before each application. Tank mixes were displaced through the respective nozzle(s) at the required spray pressure using a needle flow valve. Pressure was verified at the nozzle tip using a calibrated pressure gauge. The sprays were sampled through a full vertical traverse of the spray plume in approximately 8 to 12 seconds measured by a Malvern Spraytec laser diffraction instrument with its laser at the wind tunnel centre approximately 50 cm downwind from the nozzle. The Standard Operating Procedure (SOP) included the following actions in respective automatic order: entry of the treatment details, alignment of the laser using automatic motor control for x and y positioning, background measurement, sample light diffraction measurement during the traverse of the nozzle to provide a full spray sample from the bottom edge of the plume through the centre and then the top of the plume. Data were processed using the full measurement data of the light diffraction pattern with a model independent curve fit for droplet size in size classes up to 2000 microns.

All measurements were replicated three times.

The instrument and system calibration were verified against the American Society for Agricultural and Biological Engineers (ASABE) standard S572 reference sprays for droplet size classifications.

Adjuvants

BS1000 is a non-ionic alcohol alkoxylate (1000g/l) produced by Nufarm in Australia. It is widely used with a number of agricultural herbicides throughout Australia particularly in broad area farming. It is an amphiphilic surfactant.

PCLL8 is a multiphase wetting composition developed by Advanced Wetting Technologies Pty Ltd. It is the subject of a pending patent worldwide. It is not an amphiphilic surfactant and is not limited by the formation of micelles. It is based on completely different technology than any existing surfactant. As a result, unlike amphiphilic surfactants, it can be used at different doses. As micelles do not form there is no Marangoni Effect (lower surface tension at the edge of the droplet compared to the bulk

of the droplet). This is what causes the production of spray fines either in the air or when the drop contacts the foliage. As there is no formation of micelles, it can also be used at different doses for faster or slower spreading and penetration and for different herbicides and weed species which is unique in surfactants.

It has been tested with Roundup and Paraquat by a team of agronomists, Outlook Ag and has been found to be more effective than BS1000 even at lower doses i.e. 50ml/100 litres of PCLL8 as opposed to 125ml/100 litres of BS1000. It is also a far better performer on difficult to kill weeds such as Flea vane, Pig weed and Milk thistle while using less Roundup. This has been verified by Outlook Ag. It also is effective with lower doses of Glyphosate at 1500ml/ha as opposed to BS1000 at 2500ml/ha.

Wind Tunnel Study

The study involved four factors listed below. The experimental design of the wind tunnel trial was as follows:

Herbicide

1. Roundup Ready PL
2. Roundup Ready PL + Xtendimax 2 (a broad leaf Dicamba type herbicide)
3. Xtendimax 2 alone

Adjuvant

1. PCLL8
2. BS1000
3. LI700
4. No adjuvant

LI700 was fully analysed however is not the subject of this report because it has an inbuilt DRA and it has to be used at 250ml/100 litres of spray mix. Outlook Ag found it to be the least effective adjuvant with Roundup and Paraquat.

Drift Reduction Agent (DRA)

1. On Course FMC
2. Intact
3. Gravitate 707
4. No DRA

Nozzle type

1. AI11003
2. AVI Albuz
3. TTI60 Twin Jet

To ensure the design was fully orthogonal for Analysis of Variance, there were 144 treatments. The experimental design is in an attached file. Dynamic Surface Tension (DST) was done on all mixes (48) at both 20ms and 40ms. This data was analysed using linear regression for each nozzle type.

The data was obtained from Spraytec Software Malvern Instruments Version 4 which was used as a database, the data being transferred from Version 3 of this program. Version 3 actually runs the hardware which is a moving laser source plus an array of diodes that measures the refraction of the laser and as such calculates droplet size and distribution and records all data.

The data was checked for normality of variance, a fundamental assumption and data points with large residuals were checked for data entry error. The data was analysed using Genstat Version 7; Lawes Agricultural Trust.

There was no requirement for transformation of any of the data into natural logarithms for analysis. Where there were large residuals (substantially greater than the standard error) the data was checked. If correct the data were not excluded. The full experimental design is attached as an Appendix.

The data was analysed over the whole experiment i.e. all factors however due to the impact of nozzle type it was then reanalysed by nozzle type which enabled the regression analyses to be conducted. All of the results in this report come from the complete analyses i.e. all nozzles, DRA's, herbicides and all adjuvants. Results are presented in tabular and graphical format the latter with Least Significant Differences (LSD) bars at the 95% confidence level ($p \leq 0.05$) and p values are also displayed.

Where possible all data was obtained after the laser had tracked for 9 seconds.

Minimum size of droplets recorded was 10 μ m and the maximum size was 2500 μ m. Particles above 2500 μ m and in fact above 500 μ m have a very high likelihood of rolling off foliage.

Due to the size of the experiment and number of factors, the level of interaction was set at 2 to have sufficient degrees of freedom for error, i.e., estimate of the precision of the standard error. The following analysis is with the complete data set.

Summary

When pooled over all data it was found to a very high level of confidence:

- Adjuvants; BS1000 had substantially more fines than all of the others which would result in greater production of spray drift. This verifies previous work done with Outlook Ag agronomists. PCLL8 and LI700 had the least however LI700 contains soyal phospholipids as an emulsion which limits it's wetting ability, proven by Outlook Ag and also by AWT with goniometry studies.
- BS1000 also had the widest distribution of spray size in that it had the largest volume >1000 μ m
- Nozzles; the TTI60 Twin Jet nozzle had by far the least amount of finer particles. Albuz AVI had the smallest particle sizes.
- Herbicides; when the combination of Roundup Ready PL and Xtendimax was combined this produced the greatest volume of smaller droplets which would result in potentially greater drift.
- DRA's; Intact had the least amount of fines.

Given the previous work done by Outlook Ag and the research done at Dept Applied Mathematics at ANU as well as this wind tunnel study it has been clearly proven that:

- PCLL8 performs entirely differently to amphiphilic surfactants as proven by the dose effect caused by no micelle formation. This obviates the Marangoni Effect reducing the formation of fines. This is clearly shown out by the lack of difference between solutions without adjuvants to those with PCLL8.
- The dose effect also results in different rates of wetting.
- Surface tension alone is a poor predictor of wetting performance.
- This means that with PCLL8 there is no requirement for the use of DRA's
- The fundamental principle of DRA's is to maintain droplet integrity. This is done by coating the outside of the droplet with an immiscible liquid. This however inhibits the fundamental action of the adjuvant i.e. spreading and penetration and as a result the spray mix. They are also an additional cost, and usually result in higher spray mix volumes.

Analysis of variance All Data

Variate: Dv_10_um_Average (Average size of particles lowest 10% of volume)

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
Nozzle	2	123733.4	61866.7	252.91	<.001
Adjuvant	3	8615.0	2871.7	11.74	<.001
Herbicide	2	10282.1	5141.0	21.02	<.001
DRA	3	70956.6	23652.2	96.69	<.001
Nozzle.Adjuvant	6	6082.8	1013.8	4.14	<.001
Nozzle.Herbicide	4	10929.5	2732.4	11.17	<.001
Adjuvant.Herbicide	6	4212.4	702.1	2.87	0.013
Nozzle.DRA	6	40323.4	6720.6	27.47	<.001
Adjuvant.DRA	9	2386.3	265.1	1.08	0.382
Herbicide.DRA	6	8678.2	1446.4	5.91	<.001
Residual	96	23483.9	244.6		
Total	143	309683.7			

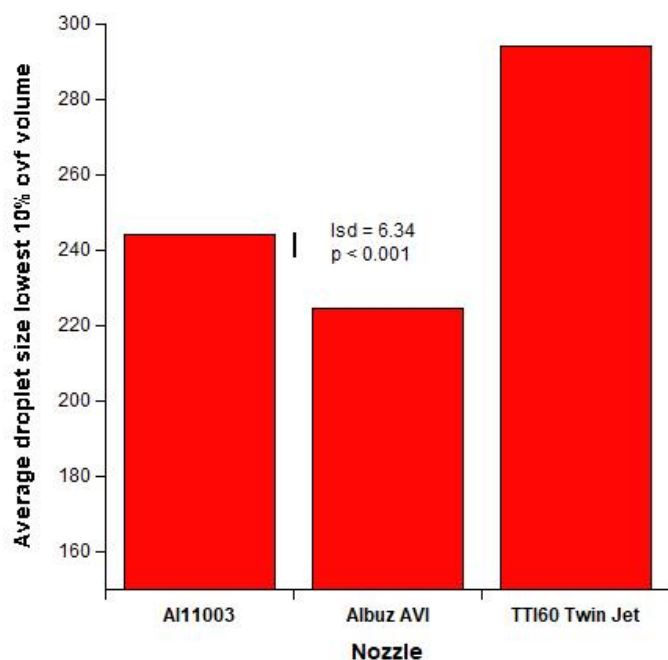
Tables of means

Variate: Dv_10_um_Average

Grand mean 254.2

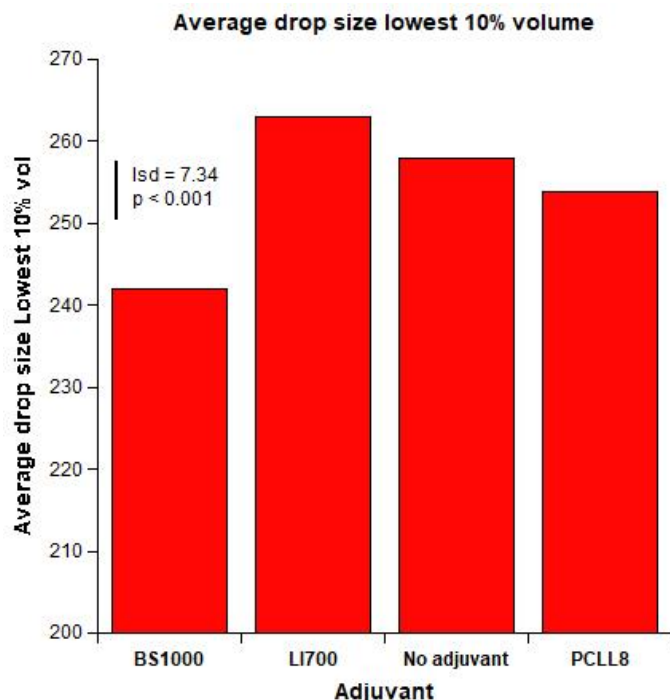
Nozzle	AI11003	Albuz AVI	TTI60 Twin Jet
	244.1	224.5	294.1

Nozzle main effect average droplet size lowest 10% volume



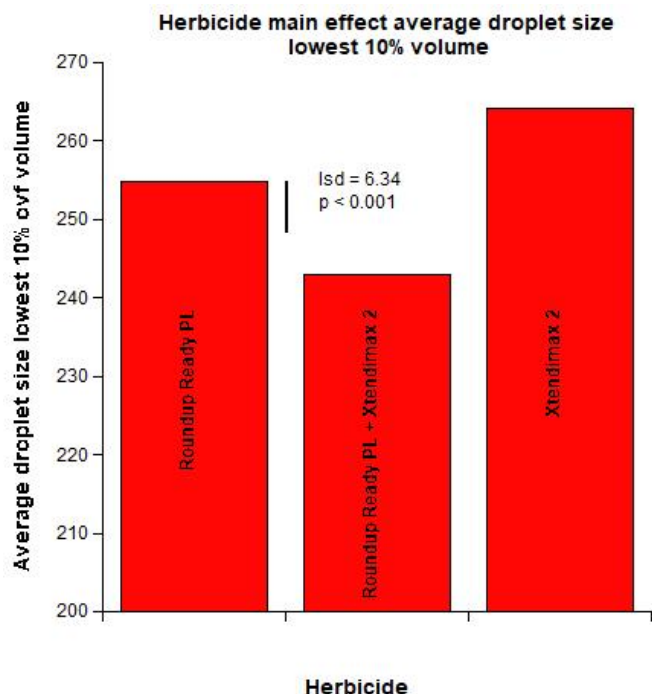
The nozzle type had a very large significant effect on droplet size when pooled over all. TTI60 Twin Jet nozzle produced the largest droplet size in this fraction, followed by AI11003 then Albuz AVI. LSD = 6.34 $p < 0.001$

adjuvant	PCLL8	BS1000	LI700	No
	242.1	263.1	257.9	253.8



The size of particles of BS1000 was significantly smaller than all other Adjuvant factors. There was no difference between No adjuvant and PCLL8 further showing proof of the absence of the Marangoni Effect. As expected LI700 produced larger droplets than PCLL8. LSD = 7.34 p < 0.001

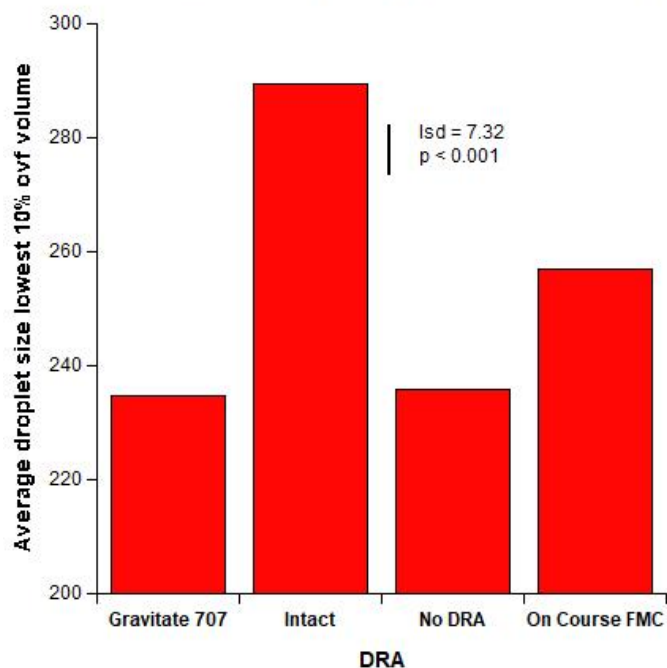
Herbicide	Roundup Ready PL	Roundup Ready PL + Xtendimax 2	Xtendimax 2
	254.9	243.	264.2



The addition of Xtendimax 2 had a negative effect on droplet size when added to Roundup Ready PL. However by itself, Xtendimax 2 had the largest droplet size greater than Roundup Ready PL which in turn was greater than the combination of Roundup Ready PL and Xtendimax 2. LSD = 6.34 p < 0.001

DRA	Gravitate 707	Intact	No DRA	On Course FMC
	234.7	289.5	235.8	256.9

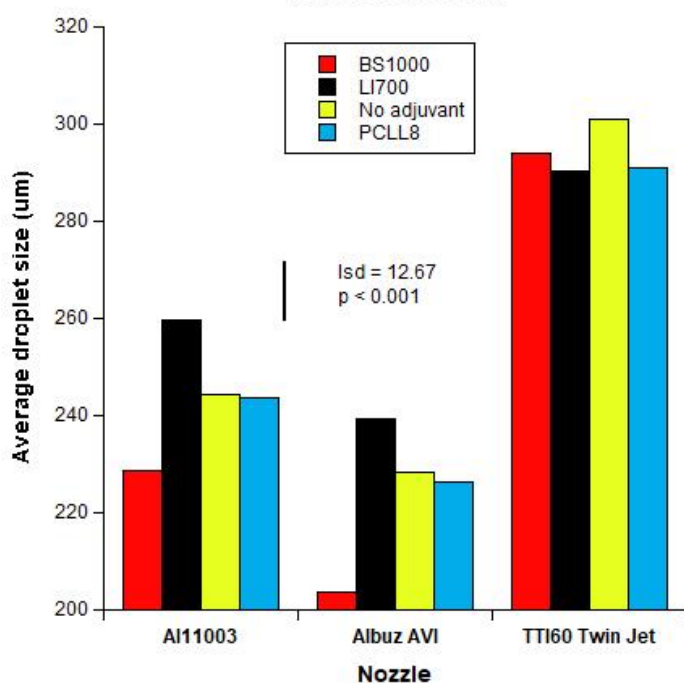
DRA main effect average droplet size lowest 10% volume



The addition of a DRA had a significant and substantial impact on droplet size which is to be expected. However, when mixed with various herbicide/adjuvant compositions, the mixes were very unstable and the emulsions broke down rapidly. It is very crude technology to reduce small droplet sizes. DRA's usually work by having an out of phase liquid on the edge of the droplet to stop the droplet breaking apart due to the Marangoni Effect. This is usually some form of emulsified oil. However this impacts on the ability for the adjuvant to spread and penetrate the spray mix into the foliage. LSD = 7.32 p < 0.001

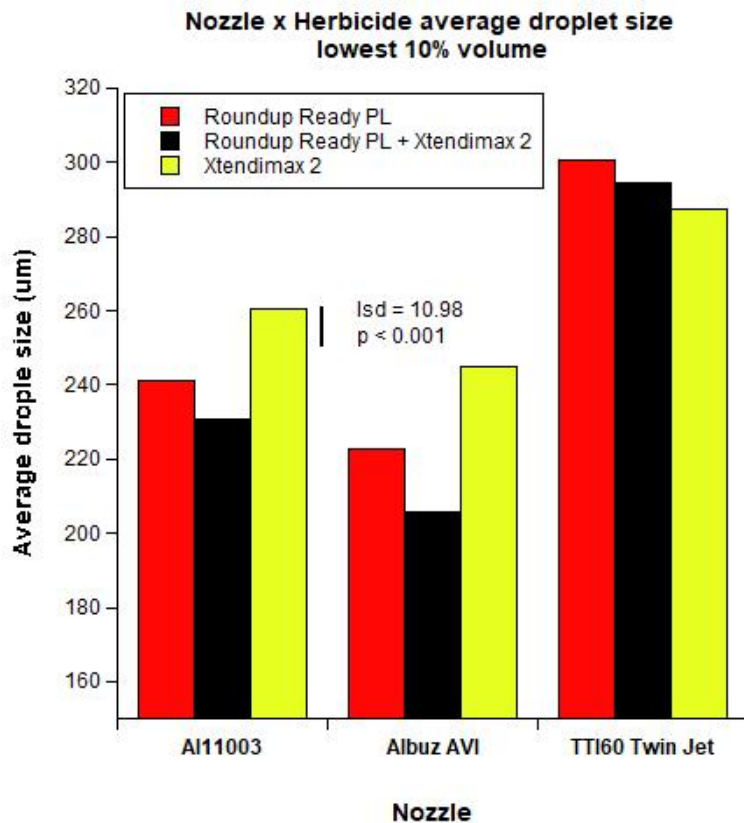
Nozzle x Adjuvant	BS1000	LI700	No adjuvant	PCLL8
AI11003	228.7	259.6	244.2	243.8
Albuz AVI	203.7	239.4	228.5	226.4
TTI60 Twin Jet	294.0	290.3	301.1	291.1

Nozzle x Adjuvant average droplet size lowest 10% volume



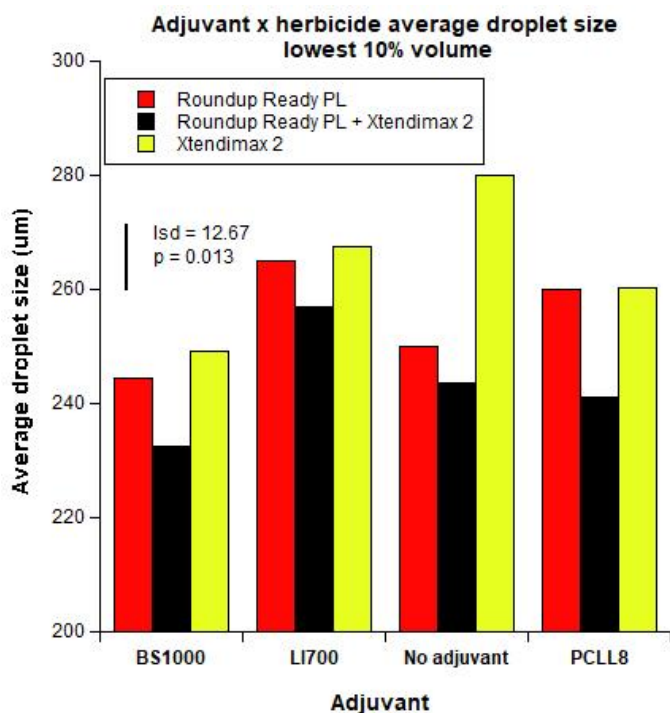
There was no significant difference between all adjuvants with the TTI60 nozzle. With both of the other nozzles BS1000 significantly had the smallest droplet size hence the significant interaction. The effect of nozzles pooled over all data is shown on page 2 where the TTI60 Twin Jet nozzle produces the largest droplet size followed by AI11003 then AVI Albuz. LSD = 12.67 p < 0.001

Nozzle x Herbicide	Roundup Ready PL	Roundup Ready PL + Xtendimax 2	Xtendimax 2
AI11003	241.1	230.6	260.4
Albuz AVI	222.9	205.6	245.0
TTI60 Twin Jet	300.6	294.5	287.3



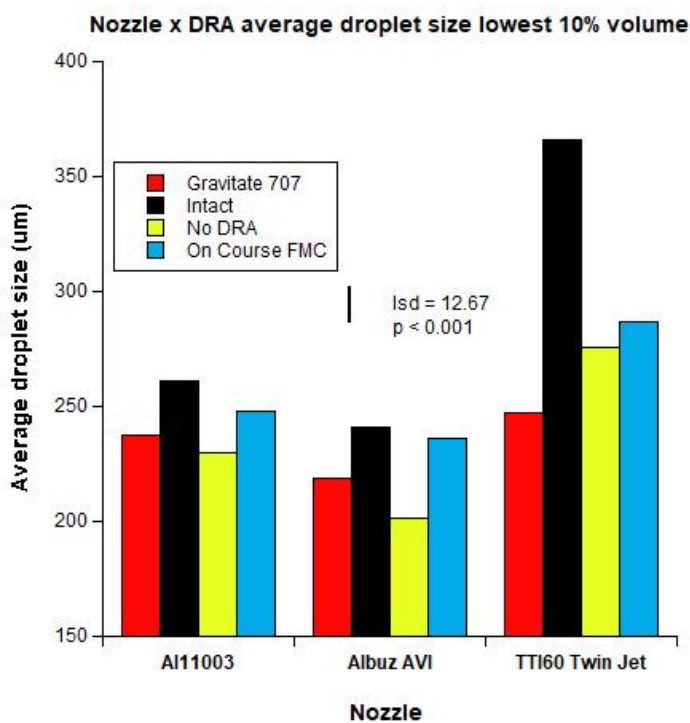
With all Nozzle x Herbicide combinations, the largest differences between herbicides were with the Albuz AVI nozzle followed by the AI11003 nozzle. There was a significant difference between Roundup Ready PL and Xtendimax 2 with the TTI60 Twin Jet nozzle. Overall the LSD = 10.98 p < 0.001

Adjuvant x Herbicide	Roundup Ready PL	Roundup Ready PL + Xtendimax 2	Xtendimax 2
BS1000	244.5	232.5	249.3
LI700	264.9	257.0	267.4
No adjuvant	250.0	243.7	280.1
PCLL8	260.1	241.1	260.2



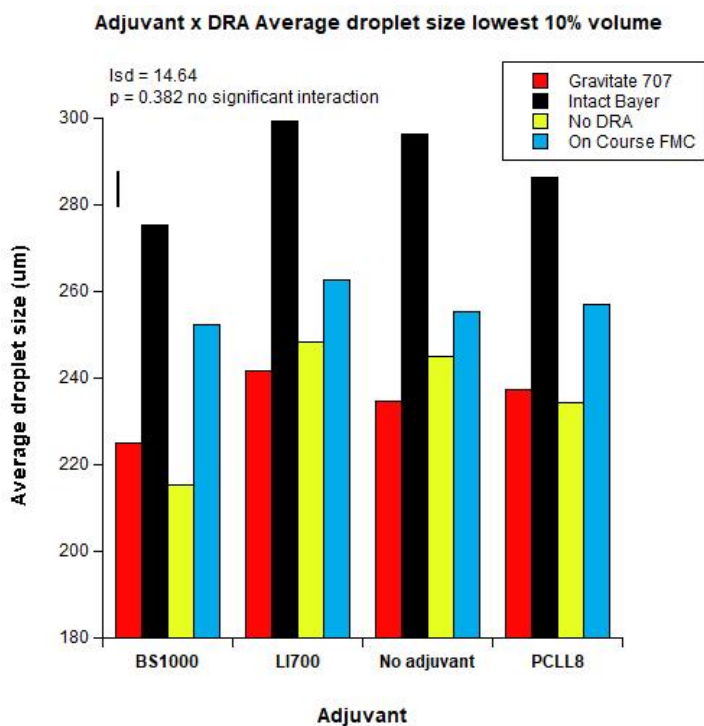
With each herbicide, BS1000 had the smallest droplet size. LSD = 12.67 p = 0.013 The significant interaction was where with No adjuvant, both of the Roundup formulations had significantly smaller droplet sizes than Xtendimax 2 by itself. The combination of Roundup Ready PL + Xtendimax 2 is problematic in regards to the generation of fines

Nozzle x DRA	Gravitate 707	Intact	No DRA	On Course FMC
AI11003	237.3	260.8	230.0	248.2
Albuz AVI	219.1	241.3	201.5	236.0
TTI60 Twin Jet	247.6	366.3	275.9	286.6



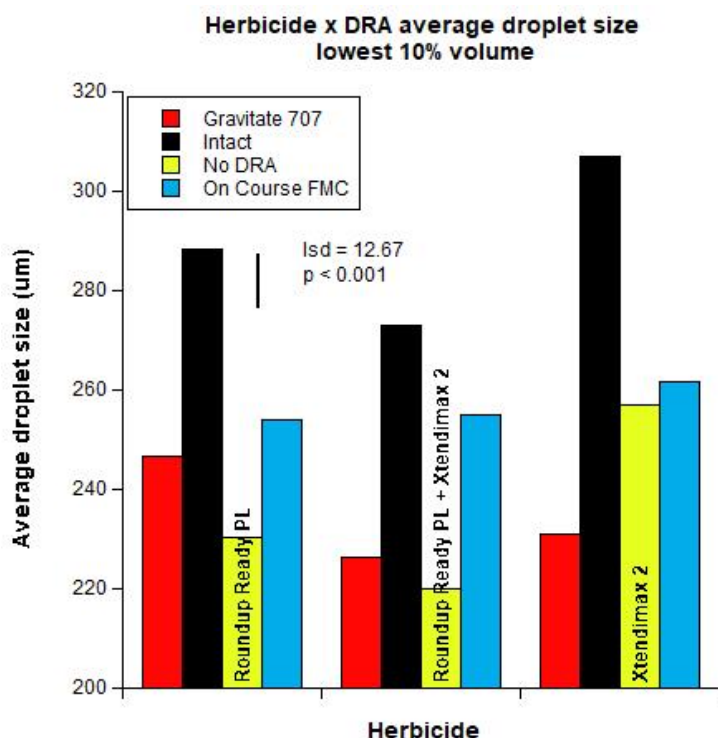
Intact produced the largest particle size with the TTI60 Twin Jet nozzle over all DRA's whereas in the other two nozzles this was not the case if No DRA is included, hence the significant interaction. With the other two nozzles Intact had significantly larger droplets compared to No DRA and Gravitate 707 i.e. another significant interaction. LSD = 12.67 p < 0.001

Adjuvant x DRA	Gravitate 707	Intact	No DRA	On Course FMC
BS1000	225.1	275.3	215.4	252.5
LI700	241.7	299.5	248.3	262.8
No adjuvant	234.6	296.5	245.0	255.5
PCLL8	237.3	286.5	234.4	256.9



No significant interactions because the order of significant differences are the same for all adjuvants. However overall BS1000 had the smallest droplet sizes. LSD = 14.64 p = 0.382

Herbicide DRA	Gravitate 707	Intact	No DRA	On Course FMC
Roundup Ready PL	246.8	288.3	230.4	254.0
Roundup Ready PL + Xtendimax 2	226.2	273.0	220.0	255.0
Xtendimax 2	231.0	307.1	257.0	261.8



Intact produced the largest droplet size over all herbicides in this volume fraction however it was difficult to mix and remain stable along with On Course FMC in the spray mixes. The significant interaction was with No DRA where with the two Roundup formulations there was no difference however with Xtendimax 2 with No DRA there was a significant increase in droplet size in this fraction. Also with Gravitate 707 with Roundup Ready PL alone there was a significant increase in droplet size over the two Xtendimax 2 combinations however there was no difference between the Xtendimax 2 combinations. LSD = 12.67 $p < 0.001$

Analysis of variance All data

Variate: Dv_10_m_Min (Minimum size of particles lowest 10% of volume)

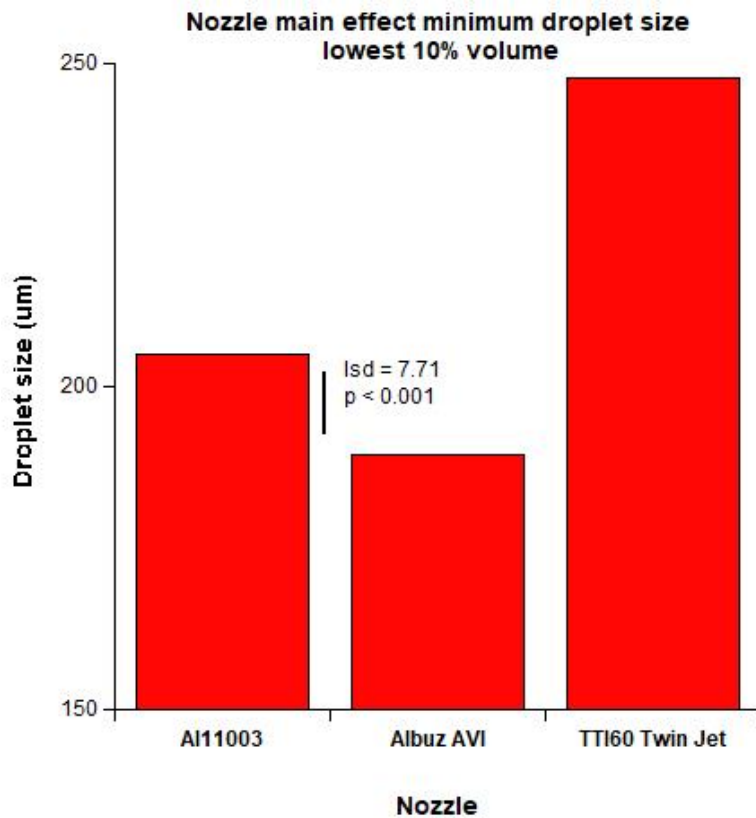
Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
Nozzle	2	87772.7	43886.3	121.16	<.001
Adjuvant	3	17890.8	5963.6	16.46	<.001
Herbicide	2	20514.1	10257.0	28.32	<.001
DRA	3	56171.2	18723.7	51.69	<.001
Nozzle.Adjuvant	6	8971.3	1495.2	4.13	<.001
Nozzle.Herbicide	4	14956.9	3739.2	10.32	<.001
Adjuvant.Herbicide	6	4269.0	711.5	1.96	0.078
Nozzle.DRA	6	57932.8	9655.5	26.66	<.001
Adjuvant.DRA	9	4292.7	477.0	1.32	0.238
Herbicide.DRA	6	14951.9	2492.0	6.88	<.001
Residual	96	34773.5	362.2		
Total	143	322496.9			

Table of Means

Variate: Dv_10_m_Min

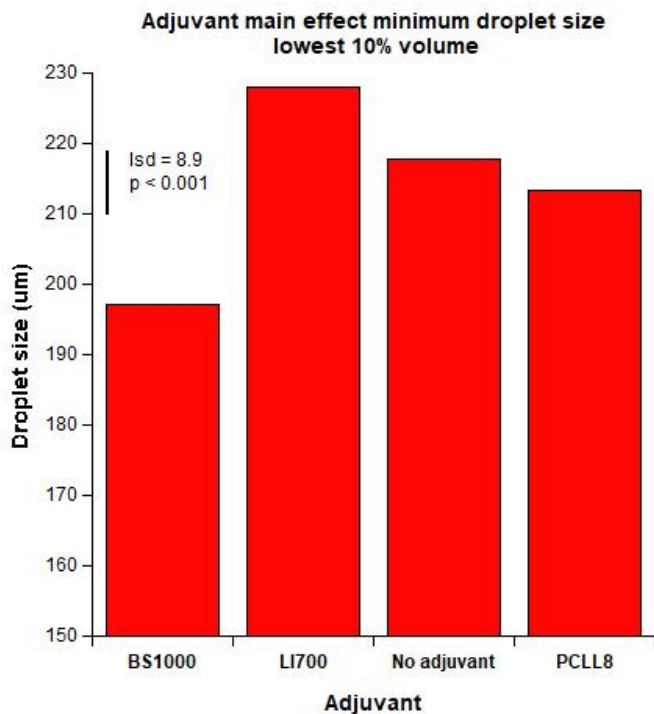
Grand mean 214.1

Nozzle	AI11003	Albuz AVI	TTI60 Twin Jet
	205.0	189.4	247.8



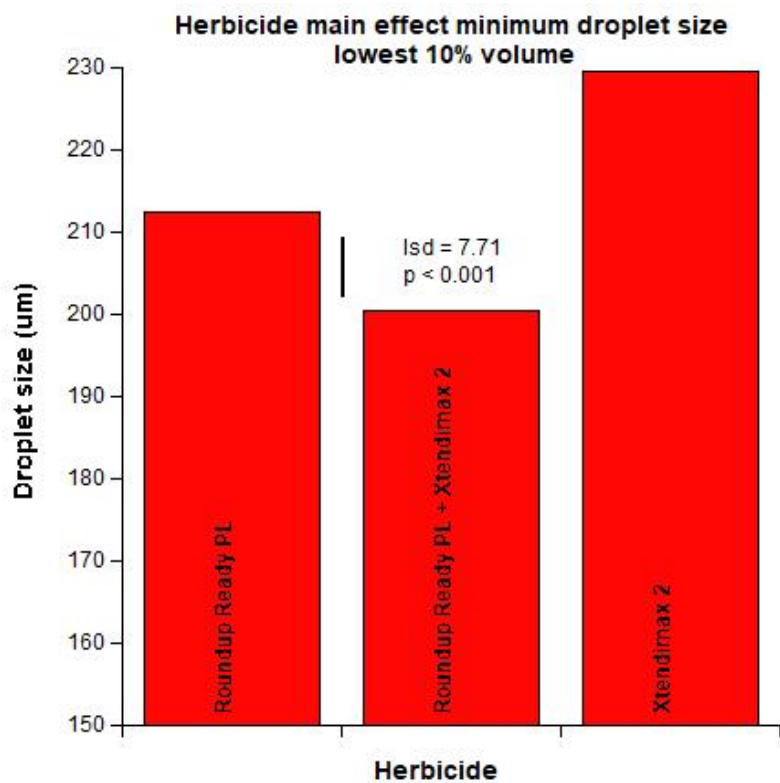
Here again there was a very large nozzle effect with TTI60 having the largest minimum droplet size in this volume fraction. There was a significant difference with all nozzle types with Albuz AVI having the smallest droplet size. LSD = 7.71 p < 0.001

Adjuvant	BS1000	LI700	No adjuvant	PCLL8
	197.1	228.0	217.8	213.4



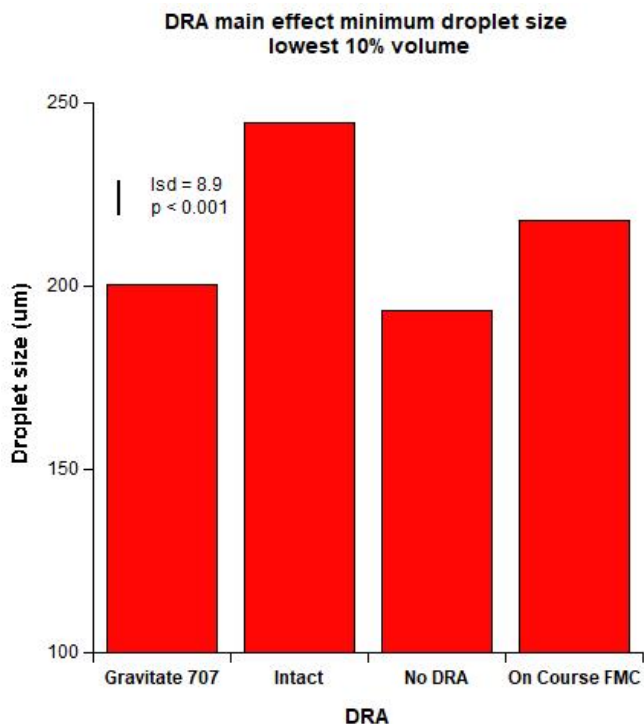
BS1000 has the smallest minimum droplet size from all of the other adjuvants. There was no difference between No adjuvant and PCLL8. LSD = 8.90 p < 0.001.

Herbicide	Roundup Ready PL	Roundup Ready PL + Xtendimax 2	Xtendimax 2
	212.4	200.4	229.5



The addition of Xtendimax 2 to Roundup Ready PL had a major effect on minimum droplet size whereas Xtendimax 2 by itself had the reverse effect. Each of the herbicides was significantly different than the other. LSD = 7.71 p < 0.001.

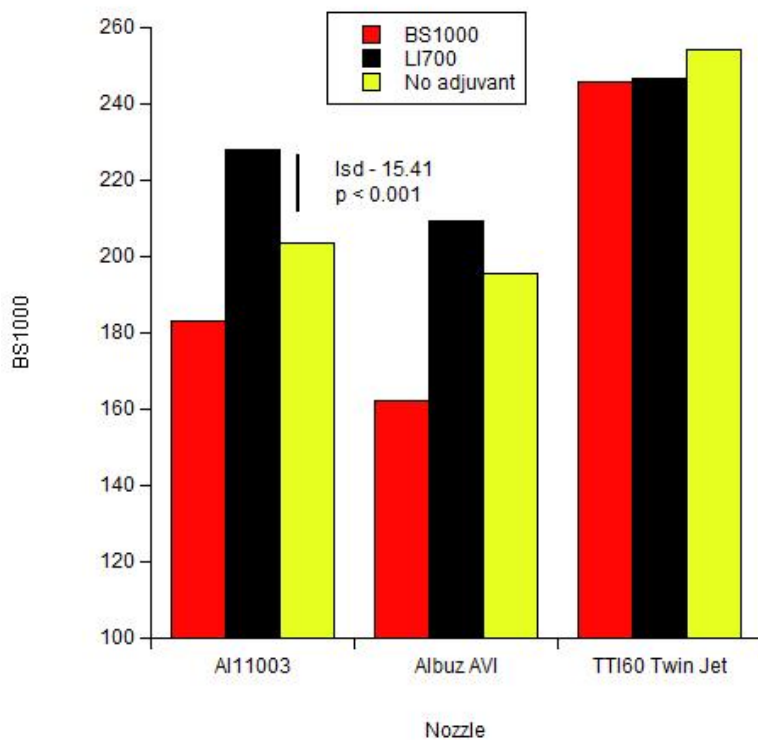
DRA	Gravitate 707	Intact	No DRA	On Course FMC
	200.4	244.6	193.4	218.0



The addition of a DRA when pooled over all data had a significant and substantial effect on the minimum droplet size. However, they are difficult to handle materials and very unstable in a tank like situation. All DRA treatments were significantly different from each other. LSD = 8.90 p < 0.001

Nozzle x Adjuvant	BS1000	LI700	No adjuvant	PCLL8
AI11003	183.1	228.1	203.4	205.4
Albuz AVI	162.3	209.2	195.6	190.5
TTI60 Twin Jet	245.9	246.8	254.2	244.4

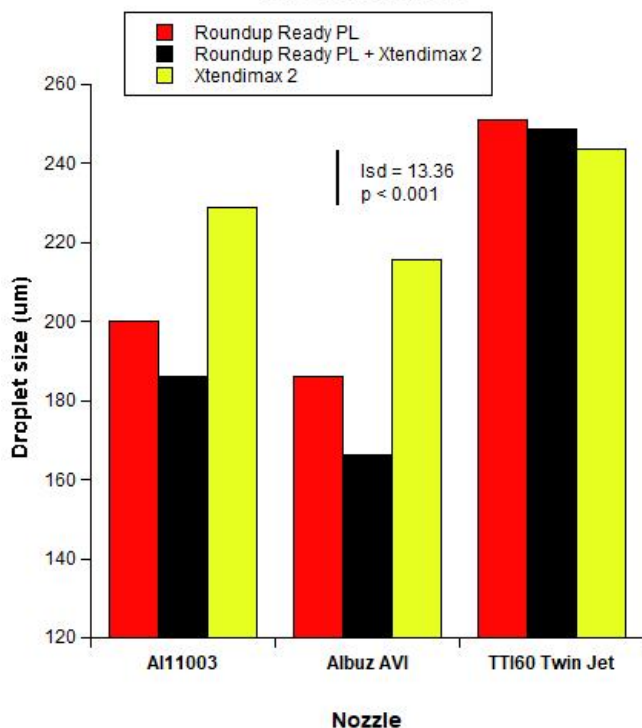
**Nozzle x Adjuvant minimum droplet size
lowest 10% volume**



There was no significant difference between all adjuvants when using the TTI60 nozzle. There were significant and substantial differences with the other two nozzles with BS1000 having the smallest minimum droplet size and the other three treatments having significantly larger minimum droplet size, hence the significant interaction. $LSD = 15.41$ $p < 0.001$.

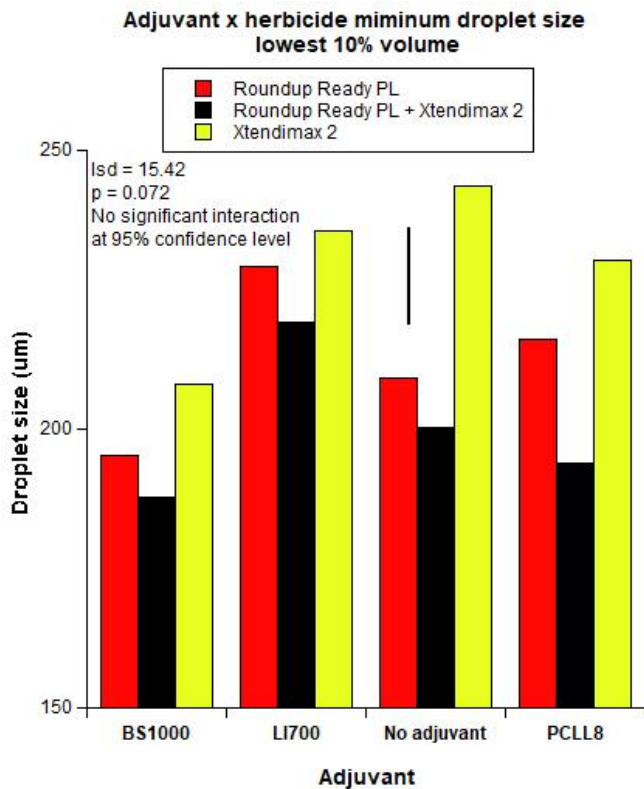
Nozzle x Herbicide	Roundup Ready PL	Roundup Ready PL + Xtendimax 2	Xtendimax 2
AI11003	200.0	186.1	229.0
Albuz AVI	186.3	166.3	215.6
TTI60 Twin Jet	250.9	248.8	243.8

**Nozzle x Herbicide minimum droplet size
lowest 10% volume**



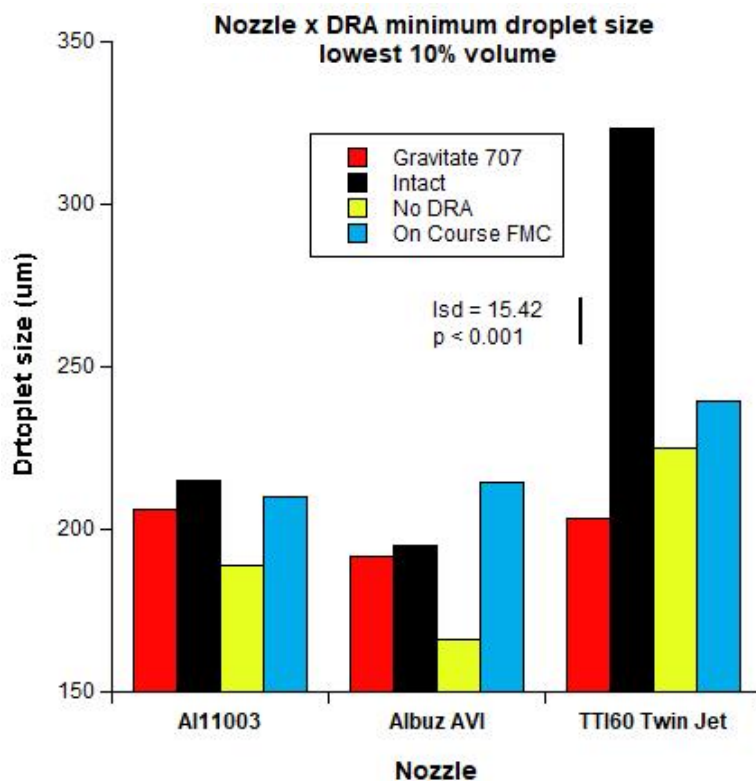
There was no difference between herbicides with the TTI60 nozzle however there was with the Albuz AVI and AI11003 nozzles with all herbicides. The combination of Roundup and Xtendimax gave the smallest droplets. There is a negative interaction between these herbicides when mixed. $LSD = 13.36$ $p < 0.001$.

Adjuvant x Herbicide	Roundup Ready PL	Roundup Ready PL + Xtendimax 2	Xtendimax 2
BS1000	195.3	187.9	208.2
LI700	229.1	219.3	235.7
No adjuvant	209.3	200.4	243.7
PCLL8	216.0	193.9	230.4



There were no significant interactions because there was no change in the order of significance. However again BS1000 had the smallest droplet size where the combination of PCLL8 with both Roundup and Xtendimax 2 the LSD was exceeded by the difference in droplet size between BS1000 and PCLL8. LSD = 15.42 p = 0.078

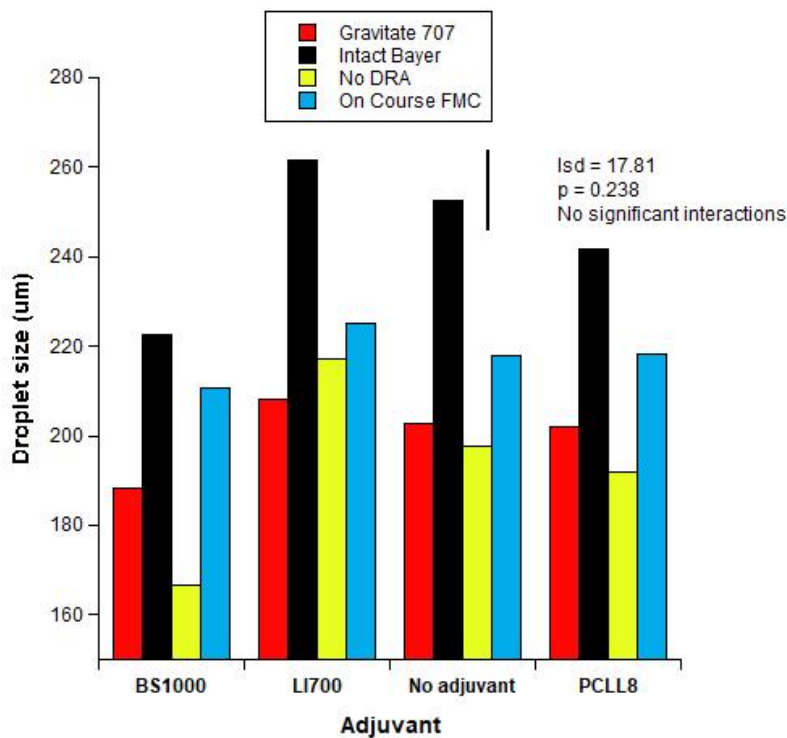
Nozzle x DRA	Gravitate 707	Intact	No DRA	On Course FMC
AI11003	205.9	215.0	189.0	210.1
Albuz AVI	191.9	195.1	166.1	204.6
TTI60 Twin Jet	203.2	323.6	225.2	239.3



The biggest difference in minimum droplet size was with the TTI60 nozzle where the use of Intact has a very large effect over all other DRA's. Both Intact and On Course had substantial increases in minimum droplet size when compared with No DRA with the other two nozzles. LSD = 15.42 p < 0.001

Adjuvant x DRA	Gravitate 707	Intact	No DRA	On Course FMC
BS1000	188.4	222.6	166.7	210.7
LI700	208.1	261.5	217.3	225.3
No adjuvant	202.9	252.5	197.8	217.8
PCLL8	202.0	241.7	191.9	218.1

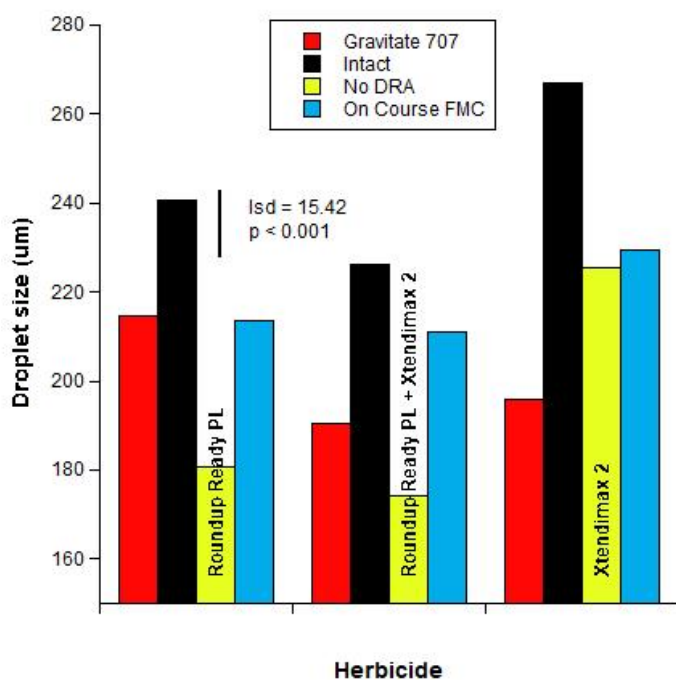
**Adjuvant x DRA Minimum droplet size
lowest 10% volume**



There were no significant interactions between Adjuvant and DRA. Check the Main effects graph for Adjuvant and DRA effects. $LSD = 17.81$
 $p = 0.238$

Herbicide x DRA	Gravitate 707	Intact	No DRA	On Course FMC
Roundup Ready PL	214.8	240.6	180.7	213.6
Roundup Ready PL + Xtendimax 2	190.3	226.2	174.1	210.9
Xtendimax 2	195.9	267.0	225.5	229.5

**Herbicide x DRA Minimum droplet
size lowest 10% volume**



There were two significant interactions, with Roundup Ready PL there was no difference between Gravitate 707 and On Course FMC however with both herbicide combinations using Xtendimax 2, Gravitate 707 had significantly smaller droplets than did On Course FMC. The other significant interaction was with No DRA where Xtendimax 2 had a significantly larger droplet size than did the Roundup formulations. Intact had the largest minimum droplet sizes with each of the herbicides. $LSD = 15.42$ $p < 0.001$

Analysis of variance All data

Variate: Dv_10_um_SD (Standard deviation in μm of size of lowest 10% volume)

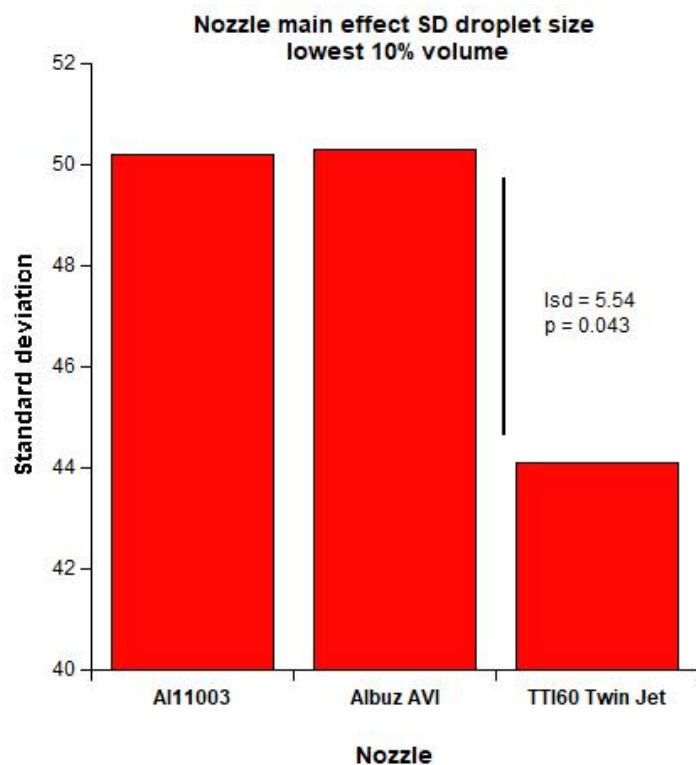
Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
Nozzle	2	1216.9	608.4	3.26	0.043
Adjuvant	3	7240.6	2413.5	12.92	<.001
Herbicide	2	6352.4	3176.2	17.01	<.001
DRA	3	15753.1	5251.0	28.12	<.001
Nozzle.Adjuvant	6	1776.9	296.1	1.59	0.160
Nozzle.Herbicide	4	1863.9	466.0	2.50	0.048
Adjuvant.Herbicide	6	3318.3	553.0	2.96	0.011
Nozzle.DRA	6	10720.9	1786.8	9.57	<.001
Adjuvant.DRA	9	2520.6	280.1	1.50	0.159
Herbicide.DRA	6	3025.3	504.2	2.70	0.018
Residual	96	17927.7	186.7		
Total	143	71716.5			

Tables of means

Variate: Dv_10_um_SD

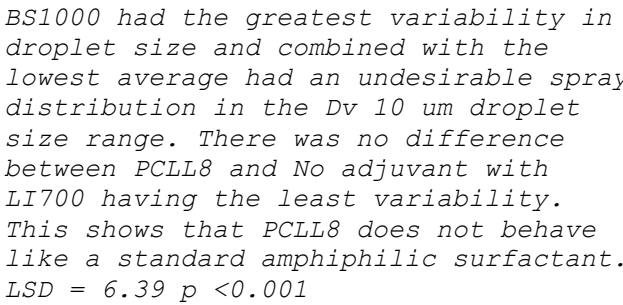
Grand mean 48.2

Nozzle	AI11003	Albuz AVI	TTI60 Twin Jet
	50.2	50.3	44.1

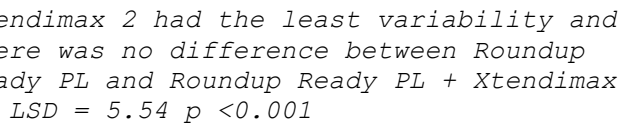


The TTI60 nozzle had the least variability and there was no difference between the other two nozzles. LSD = 5.54 p = 0.043

BS1000 had the greatest variability in droplet size and combined with the lowest average had an undesirable spray distribution in the Dv 10 um droplet size range. There was no difference between PCLL8 and No adjuvant with LI700 having the least variability. This shows that PCLL8 does not behave like a standard amphiphilic surfactant. LSD = 6.39 p <0.001



Xtendimax 2 had the least variability and there was no difference between Roundup Ready PL and Roundup Ready PL + Xtendimax
LSD = 5.54 $p < 0.001$



DRA

Gravitate 707
35.5

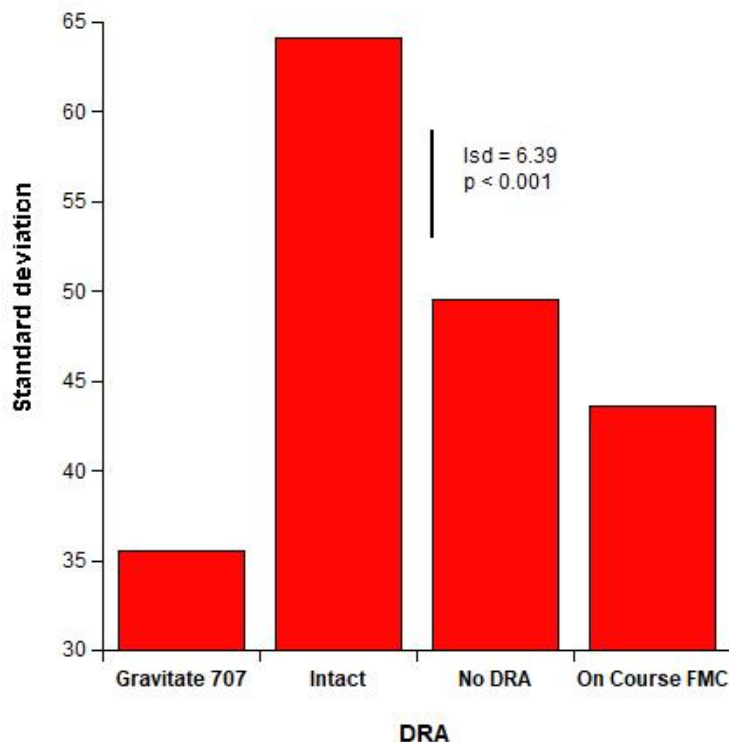
Intact
64.1

No DRA
49.5

On Course FMC
43.6

DRA main effect SD droplet size
lowest 10% volume

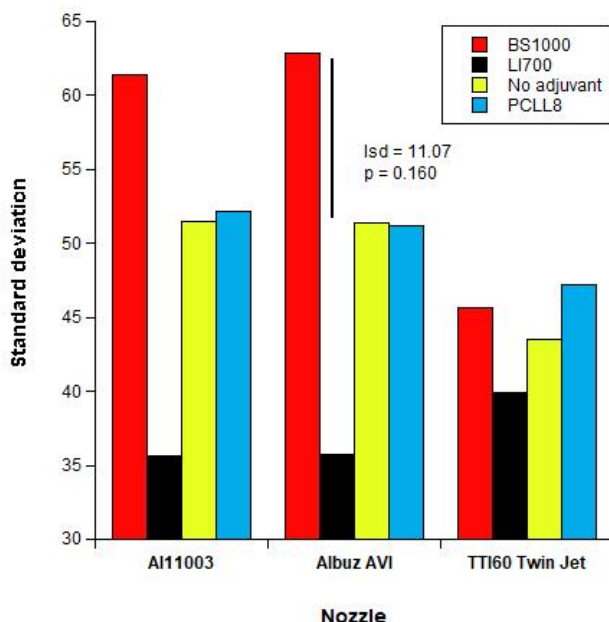
Impact Bayer had the largest variability. There was no difference between No DRA and On Course FMC. Gravitate 707 had the least variability. LSD = 6.39 p <0.001



Nozzle x Adjuvant	BS1000	LI700	No adjuvant	PCLL8
AI11003	61.4	35.6	51.5	52.2
Albuz AVI	62.9	35.7	51.4	51.2
TTI60 Twin Jet	45.7	39.9	43.5	47.2

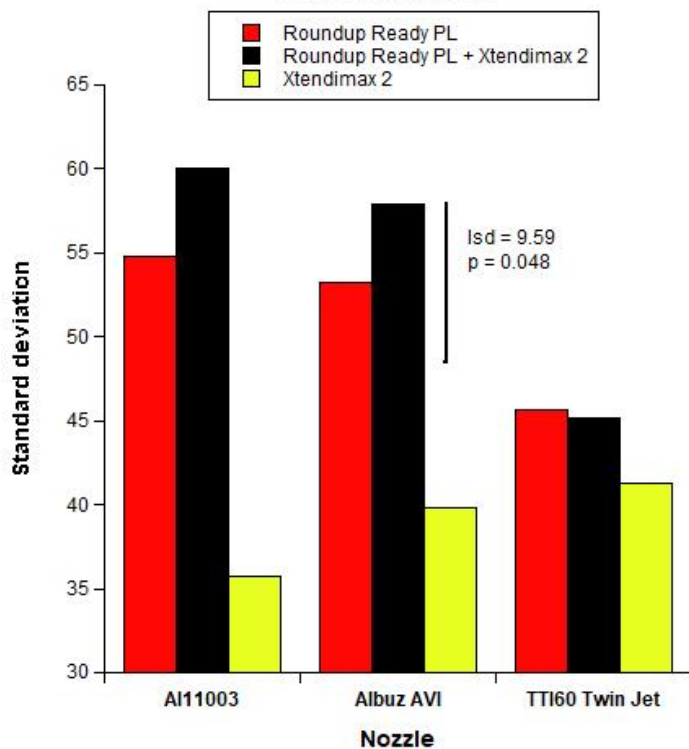
Nozzle x Adjuvant SD droplet size
lowest 10% volume

There were no significant interactions in variability however when pooled over all data, BS1000 had the greatest variability over the two nozzles AI11003 and Albuz AVI. LSD = 11.07 p = 0.160



Nozzle x Herbicide	Roundup Ready PL	Roundup Ready PL + Xtendimax 2	Xtendimax 2
AI11003	54.8	60.0	35.7
Albuz AVI	53.2	57.9	39.8
TTI60 Twin Jet	45.7	45.2	41.3

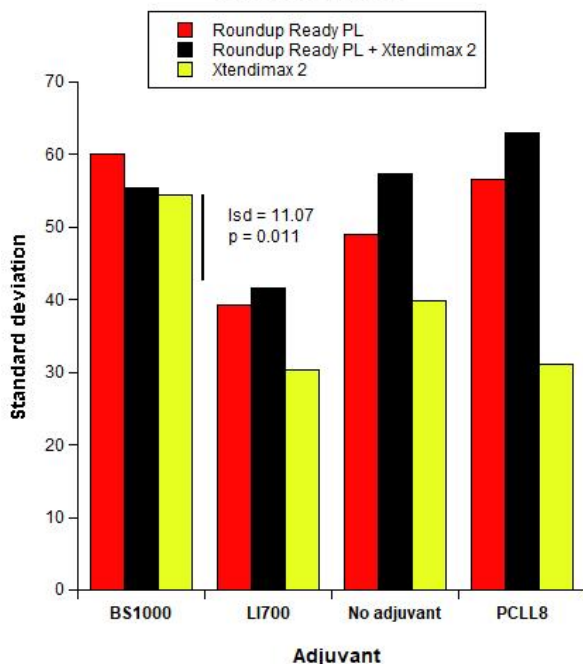
**Nozzle x Herbicide SD droplet size
lowest 10% volume**



With the TTI60 Twin Jet nozzle there was no difference in the variability between the three herbicides. however there was a significant difference in variability of droplet size with Roundup Ready PL + Xtendimax 2 and Xtendimax 2 alone with the other two nozzles hence the significant interaction. $LSD = 9.59$ $p = 0.048$

Adjuvant x Herbicide	Roundup Ready PL	Herbicide	Roundup Ready PL + Xtendimax2	Xtendimax2
BS1000	60.1		55.5	54.4
LI700	39.2		41.6	30.3
No adjuvant	49.0		57.4	39.9
PCLL8	56.5		63.0	31.2

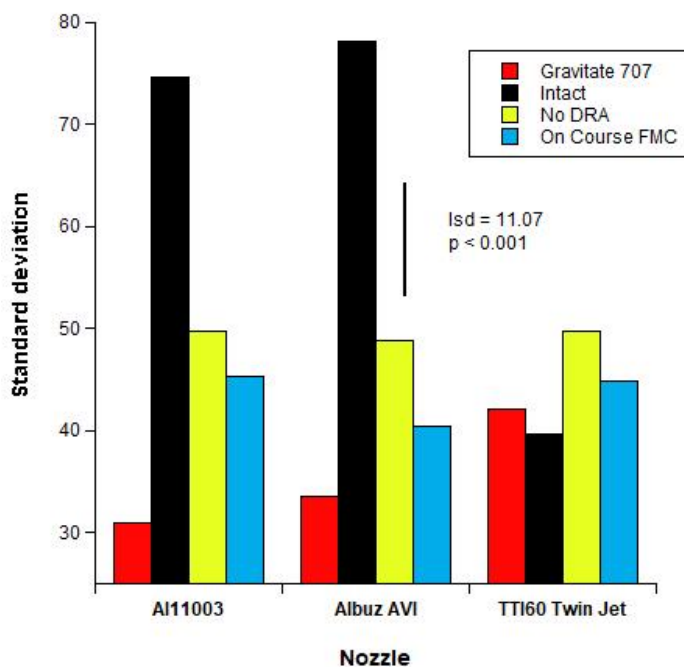
**Adjuvant x herbicide SD droplet size
lowest 10% volume**



There was no difference between the variability of all herbicides with both BS1000 and LI700. PCLL8 and LI700 had the lowest variability with Xtendimax 2 and LI700 had the least variability over all three herbicides. The interaction was with BS1000 and LI700 where there was no difference between any of the herbicides. There was no significant difference between No adjuvant and PCLL8 however there was a difference with PCLL8 between Roundup Ready PL + Xtendimax 2 and Xtendimax 2 alone, hence the significant interaction. $LSD = 11.07$ $p = 0.011$

Nozzle x DRA	Gravitate 707	Intact	No DRA On	Course FMC
AI11003	30.9	74.7	49.8	45.3
Albuz AVI	33.6	78.2	48.9	40.5
TTI60 Twin Jet	42.1	39.6	49.8	44.9

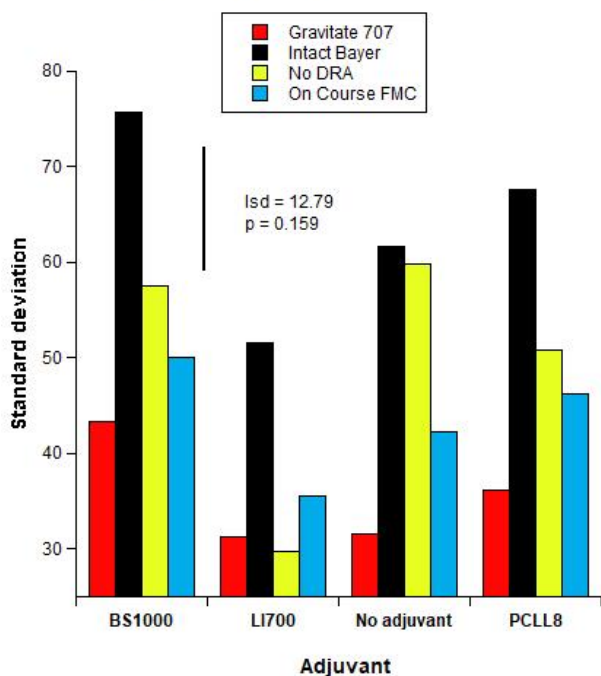
**Nozzle x DRA SD droplet size
lowest 10% volume**



Intact had the largest variability with the AI11003 and Albuz AVI nozzles. Note the interaction where with the TTI60 Twin Jet nozzle compared to the other two nozzles there was no difference in variability between all of the DRA's. With the AI11003 and Albuz AVI nozzles, Gravitate 707 had the least variability. $LSD = 11.07$ $p < 0.001$

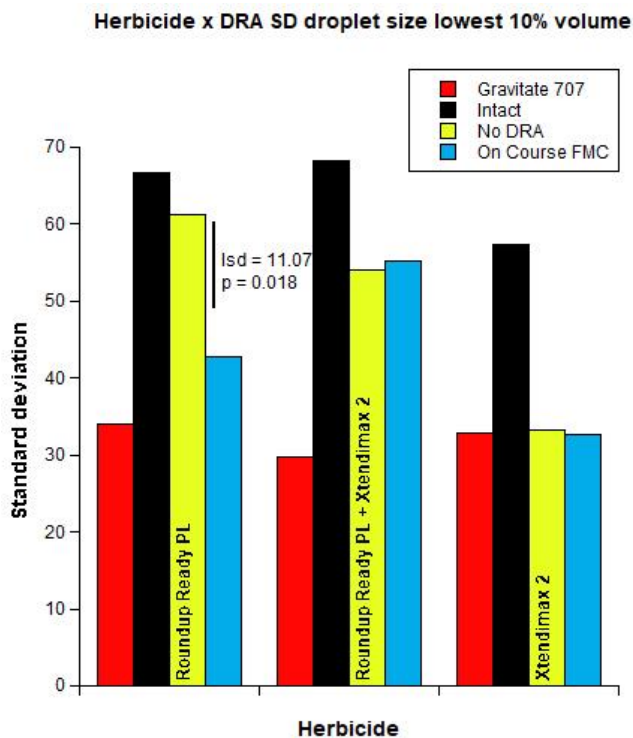
Adjuvant x DRA	Gravitate 707	Intact	No DRA	On Course FMC
BS1000	43.3	75.7	57.6	50.1
LI700	31.2	51.6	29.8	35.6
No adjuvant	31.5	61.6	59.8	42.2
PCLL8	36.1	67.7	50.8	46.3

Adjuvant x DRA SD lowest 10% volume



There were no significant interactions. $LSD = 12.79$ $p = 0.159$ While there was no significant interaction Intact had the largest variability when pooled over all data. Gravitate 707 had the least when pooled over all data. This can be seen above with the graph of DRA main effects.

Herbicide x DRA	Gravitate 707	Intact	No DRA	On Course FMC
Roundup Ready PL	34.1	66.8	61.2	42.8
Roundup Ready PL + Xtendimax 2	39.8	68.3	54.1	55.3
Xtendimax 2	32.8	57.3	33.2	32.6



Intact had the highest overall variability but there was no difference between nozzles with Impact, On Course FMC in combination with Roundup Ready PL + Xtendimax 2 was significantly different than the other two herbicides, and there was no effect with Gravitate 707 and all of the herbicides hence the significant interaction. $LSD = 11.07$ $p = 0.018$

Analysis of variance All data

Variate: %V_100_%_Average (Percentage of Volume <100µm)

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
Nozzle	2	9.50770	4.75385	67.51	<.001
Adjuvant	3	1.97543	0.65848	9.35	<.001
Herbicide	2	0.53920	0.26960	3.83	0.025
DRA	3	4.08763	1.36254	19.35	<.001
Nozzle.Adjuvant	6	1.93754	0.32292	4.59	<.001
Nozzle.Herbicide	4	1.84732	0.46183	6.56	<.001
Adjuvant.Herbicide	6	1.25565	0.20928	2.97	0.010
Nozzle.DRA	6	3.15437	0.52573	7.47	<.001
Adjuvant.DRA	9	1.41203	0.15689	2.23	0.026
Herbicide.DRA	6	2.56033	0.42672	6.06	<.001
Residual	96	6.76029	0.07042		
Total	143	35.03748			

Tables of means

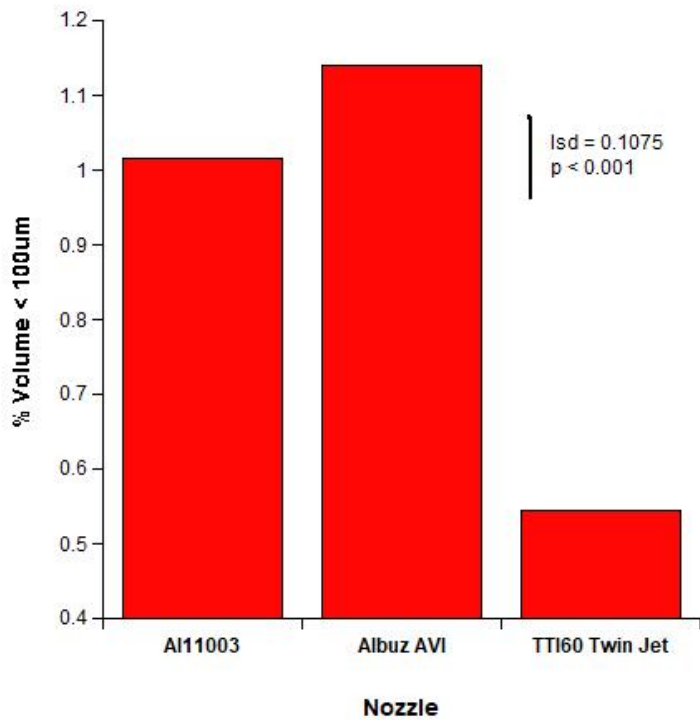
Variate: %V_100_%_Average

Grand mean 0.900

Nozzle	AI11003	Albuz AVI	TTI60 Twin Jet
	1.015	1.141	0.544

Nozzle main effect % Volume less than 100um

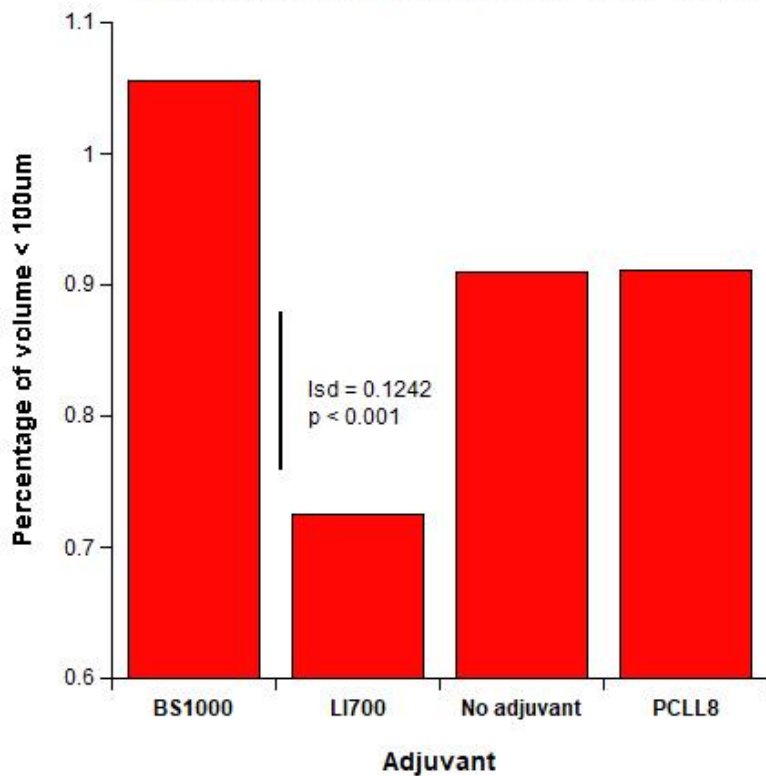
Albuz AVI had a significantly larger volume <100 um than the other two with the TTI60 Twin Jet nozzle having substantially less. LSD = 0.1075 p <0.001



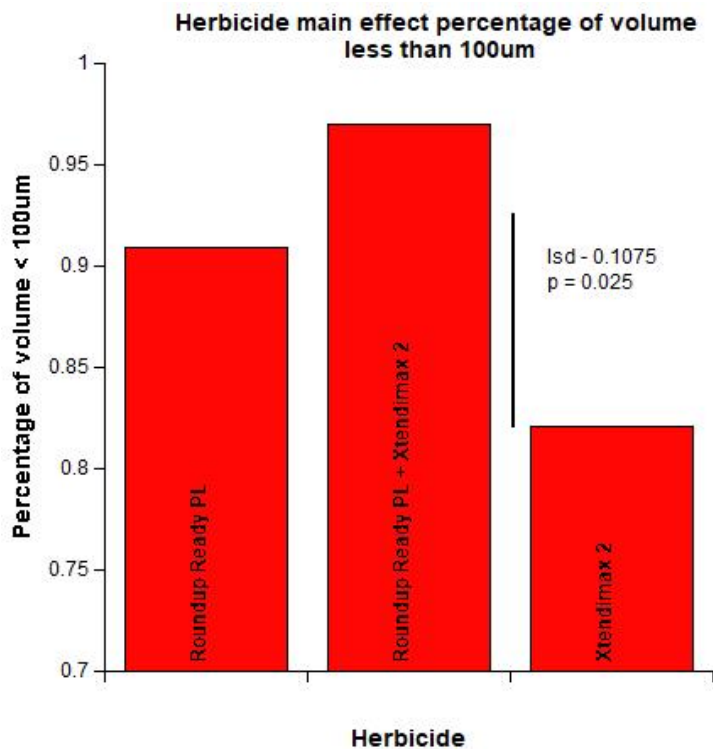
Adjuvant	BS1000	LI700	No adjuvant	PCLL8
	1.055	0.725	0.910	0.911

Adjuvant percentage of volume less than 100um

BS1000 had a significantly larger volume of droplets <100um than any other adjuvant. Note there is no difference between PCLL8 and No Adjuvant. LI700 has an inbuild DRA hence the lower volume in this size fraction. LSD = 0.1242 p <0.001

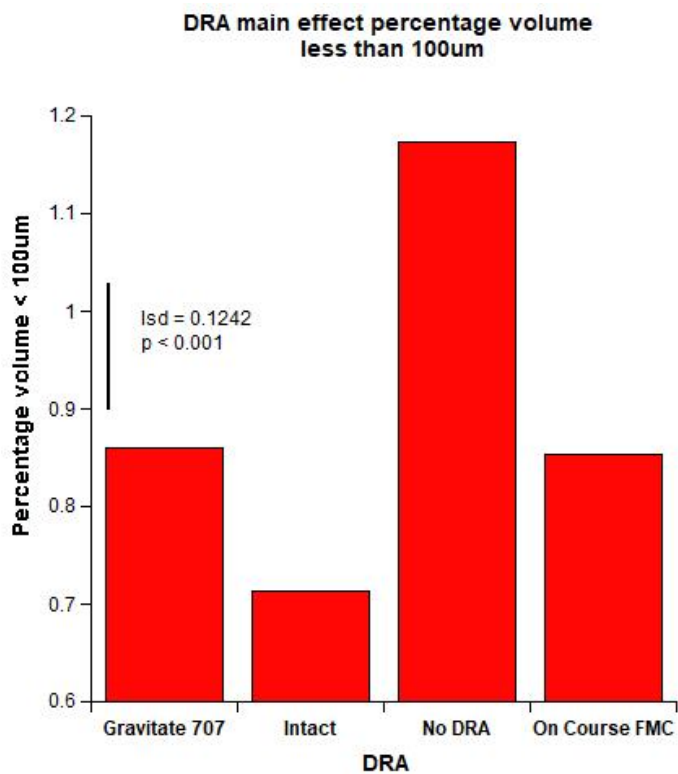


Herbicide	Roundup Ready PL	Roundup Ready PL + Xtendimax 2	Xtendimax 2
	0.909	0.970	0.821



Roundup Ready PL + Xtendimax had significantly larger volume of droplets over Xtendimax 2 <100um. There was no difference between both of the Roundup formulations LSD = 0.1075 p 0.025

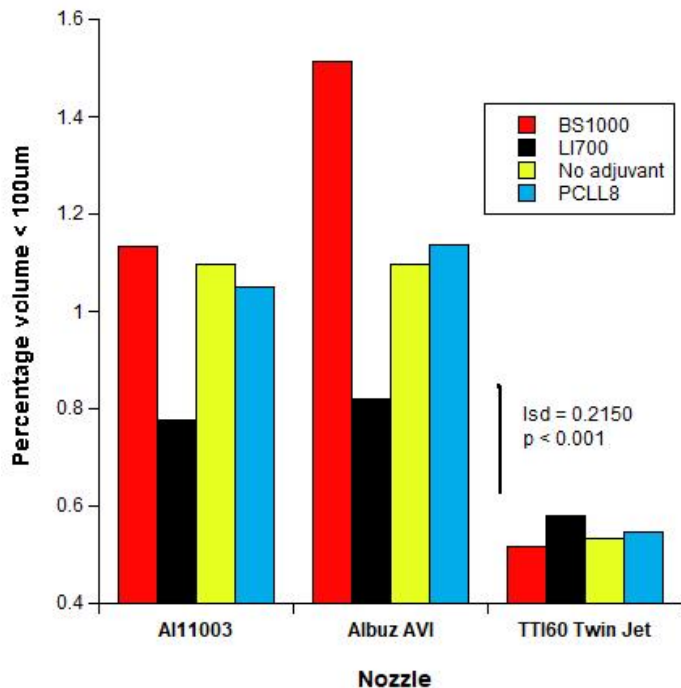
DRA	Gravitate 707	Intact	No DRA	On Course FMC
	0.860	0.713	1.174	0.854



Intact has the smallest volume in this fraction and No DRA the largest. There is no difference between Gravitate 707 and On Course FMC. LSD = 0.1242 p <0.001

Nozzle x Adjuvant	BS1000	LI700	No adjuvant	PCLL8
AI11003	1.135	0.776	1.098	1.051
Albuz AVI	1.513	0.819	1.097	1.137
TTI60 Twin Jet	0.517	0.580	0.534	0.546

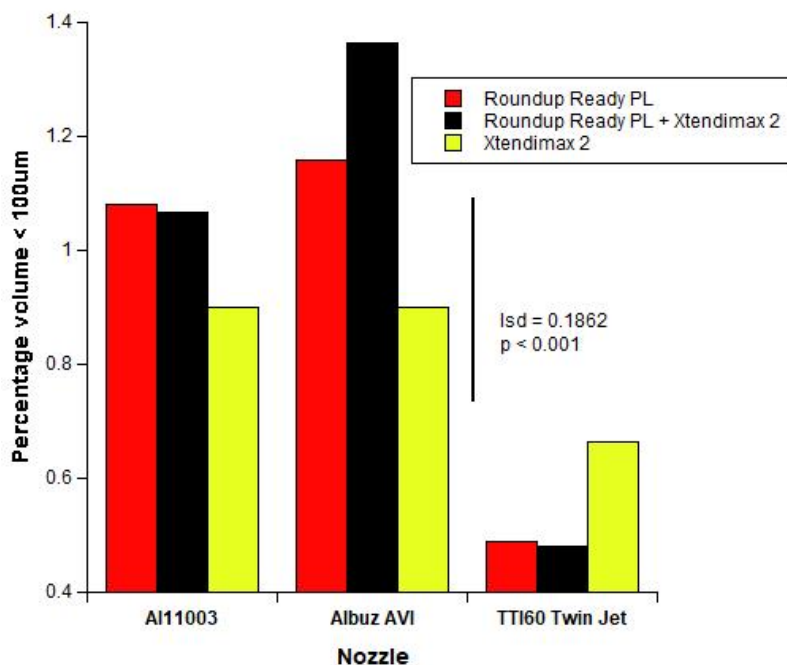
Nozzle x adjuvant percentage volume less than 100um



BS1000 had the largest volume with AI11003 and Albuz AVI nozzles and LI700 the smallest volume with those nozzles. There were no significant differences between the adjuvants in combination with the TTI60 nozzle hence the significant interaction. $LSD = 0.2150$ $p < 0.001$

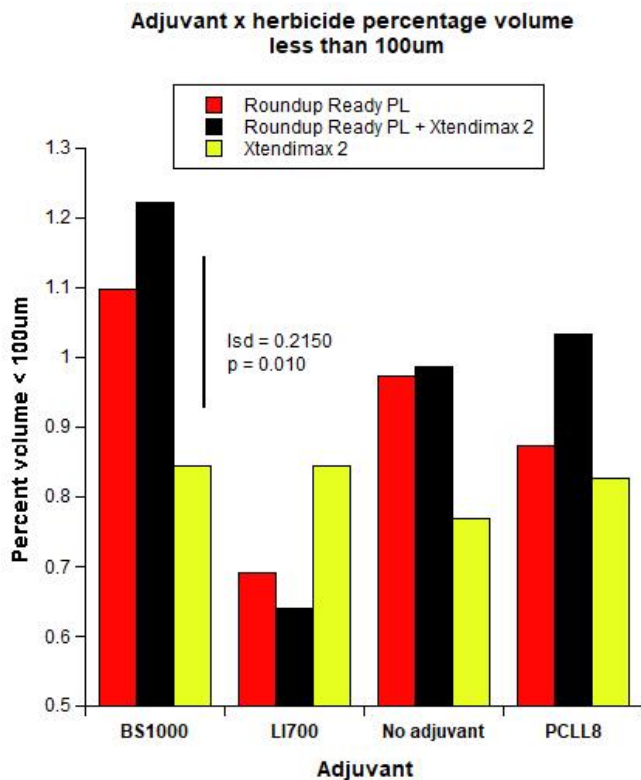
Nozzle x Herbicide	Roundup Ready PL	Roundup Ready PL + Xtendimax 2	Xtendimax 2
AI11003	1.080	1.067	0.899
Albuz AVI	1.159	1.364	0.901
TTI60 Twin Jet	0.489	0.481	0.664

Nozzle x Herbicide percentage volume less than 100um



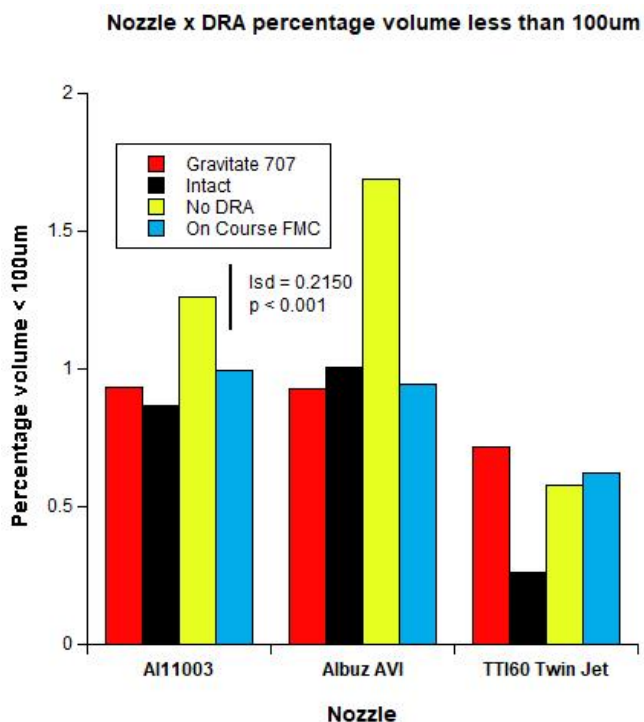
There was no significant difference between herbicides with the use of the TTI Twin Jet and AI11003 nozzles however with the Albuz AVI nozzle there was a significant difference between Roundup Ready PL + Xtendimax 2 and Xtendimax 2 hence the significant interaction. $LSD = 0.1862$ $p < 0.001$

Adjuvant x Herbicide	Roundup Ready PL	Roundup Ready PL + Xtendimax 2	Xtendimax 2
BS1000	1.097	1.222	0.845
LI700	0.692	0.639	0.844
No adjuvant	0.974	0.987	0.768
PCLL8	0.874	1.033	0.827



With Roundup Ready PL the volume of fine spray droplets was significantly greater with BS1000 than with Xtendimax 2. There was no significant difference with any of the other herbicide x adjuvant combinations, hence the significant interaction. $LSD = 0.2150$ $p = 0.010$

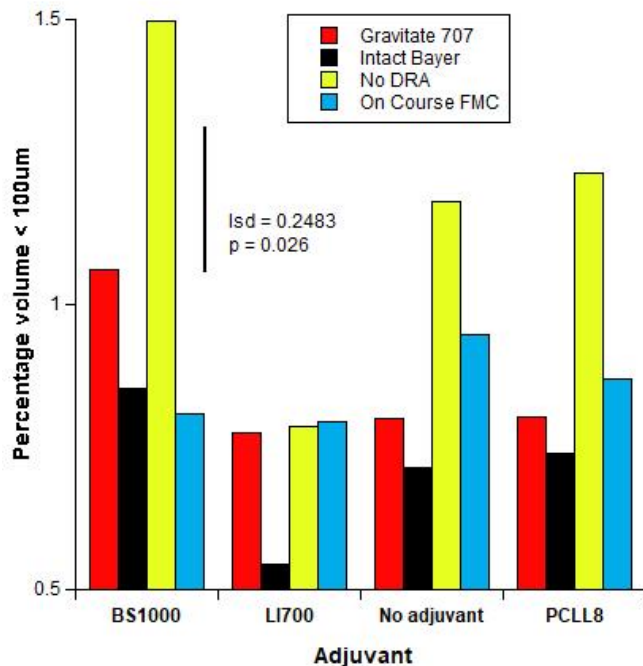
Nozzle x DRA	Gravitate 707	Intact	No DRA	On Course FMC
AI11003	0.936	0.869	1.259	0.996
Albuz AVI	0.928	1.008	1.687	0.943
TTI60 Twin Jet	0.715	0.262	0.576	0.624



With the AI11003 and Albuz AVI nozzles there was a significant difference between No DRA and all other DRA's. However with the TTI60 Twin Jet nozzle, Intact had significantly lower volume than all of the other DRA treatments, hence the significant interaction. $LSD = 0.2150$ $p < 0.001$

Adjuvant x DRA	Gravitate 707	Intact	No DRA	On Course FMC
BS1000	1.062	0.854	1.497	0.808
LI700	0.775	0.545	0.786	0.795
No adjuvant	0.799	0.714	1.180	0.946
PCLL8	0.803	0.740	1.232	0.869

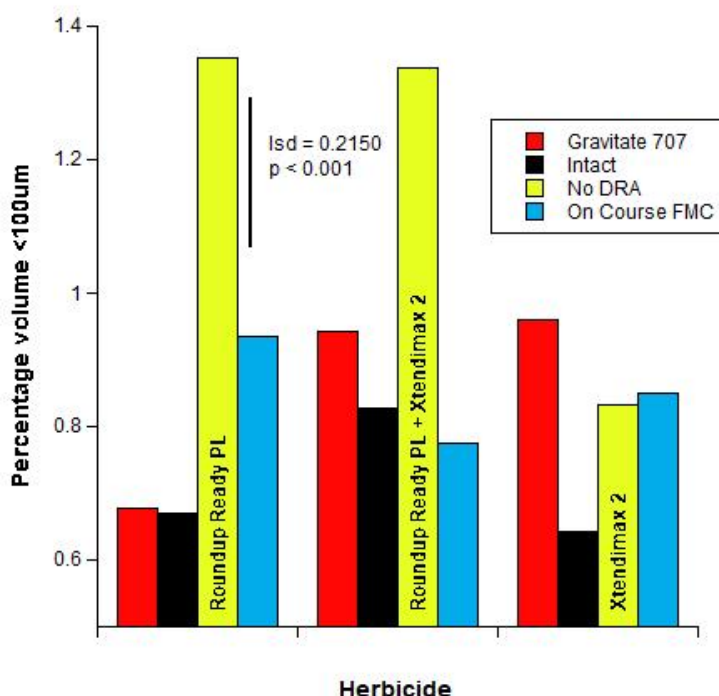
Adjuvant x DRA percentage volume less than 100um



The significant interaction is where with BS1000, the No DRA treatment had the greatest volume where with LI700 there was no significant difference between any of the DRA's. With No adjuvant, No DRA had significantly higher volumes than Gravitate 707 and Impact, and with PCLL8, No DRA had a significantly greater volume than all other DRA's. Therefore, to use BS1000 one would have to use a DRA which as will be shown leads to mix stability problems and spray droplets that are too large, as well as a reduction in efficacy of the adjuvant. LSD = 0.2483 p = 0.026

Herbicide x DRA	Gravitate 707	Intact	No DRA	On Course FMC
Roundup Ready PL	0.678	0.670	1.353	0.936
Roundup Ready PL + Xtendimax 2	0.942	0.827	1.337	0.776
Xtendimax 2	0.960	0.642	0.832	0.851

Herbicide x DRA percentage volume less than 100um



The only difference in volume between Gravitate 707 and Intact was with Xtendimax 2. With No DRA, the Xtendimax 2 had significantly less volume than the Roundup combinations. Herbicide type had no effect with the addition of On Course FMC, hence the significant interaction. LSD = 0.2150 p < 0.001

Analysis of variance All data

Variate: %V_150_%_Average (Percentage of Volume <150µm)

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
Nozzle	2	75.5462	37.7731	73.55	<.001
Adjuvant	3	30.4207	10.1402	19.74	<.001
Herbicide	2	23.4571	11.7285	22.84	<.001
DRA	3	32.0958	10.6986	20.83	<.001
Nozzle.Adjuvant	6	16.9126	2.8188	5.49	<.001
Nozzle.Herbicide	4	19.6521	4.9130	9.57	<.001
Adjuvant.Herbicide	6	5.8136	0.9689	1.89	0.091
Nozzle.DRA	6	24.4429	4.0738	7.93	<.001
Adjuvant.DRA	9	9.8463	1.0940	2.13	0.034
Herbicide.DRA	6	18.1761	3.0293	5.90	<.001
Residual	96	49.3043	0.5136		
Total	143	305.6677			

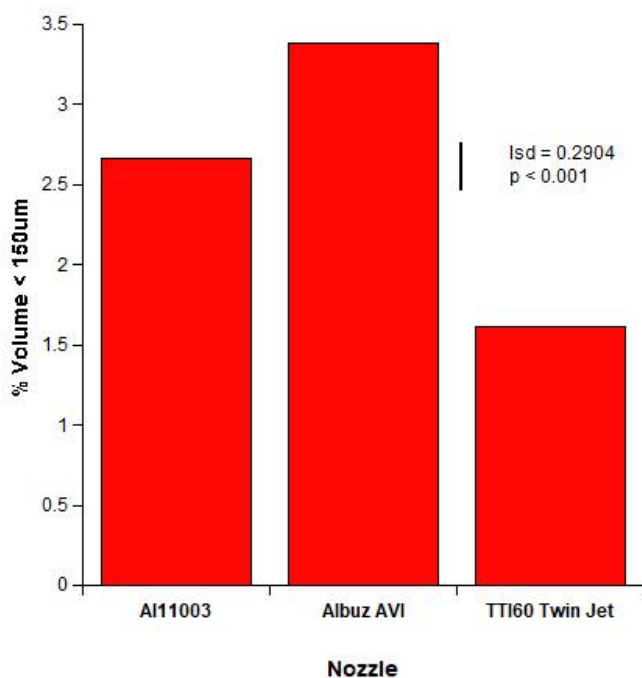
Tables of means

Variate: %V_150_%_Average

Grand mean 2.555

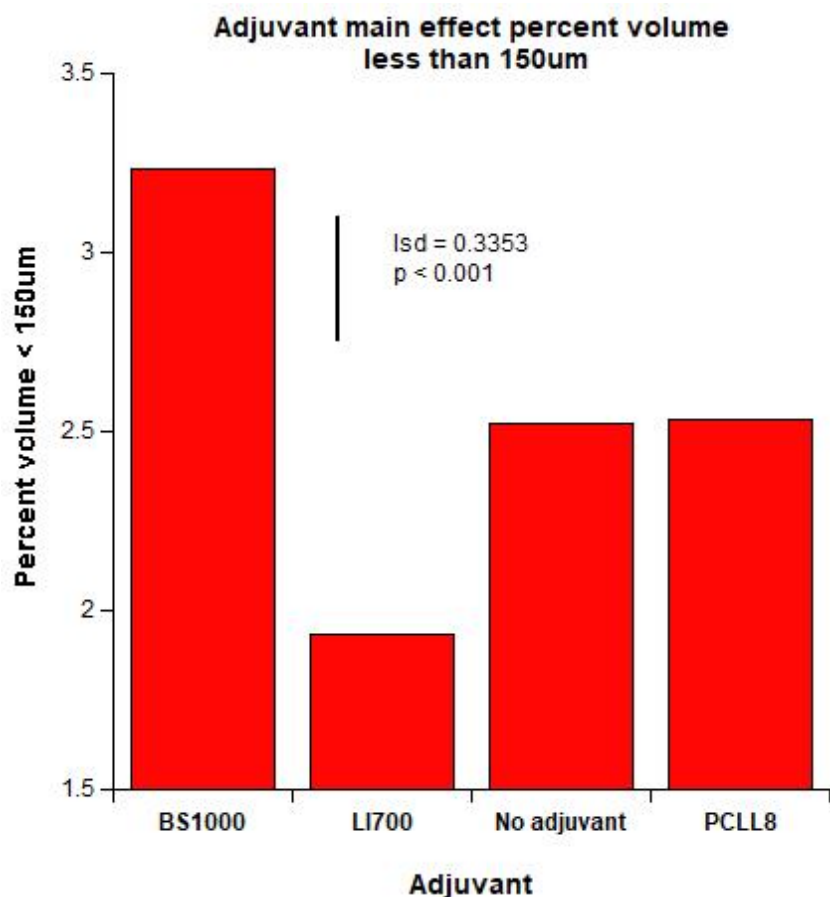
Nozzle	AI11003	Albuz AVI	TTI60 Twin Jet
	2.667	3.381	1.617

Nozzle main effect % Volume less than 150µm



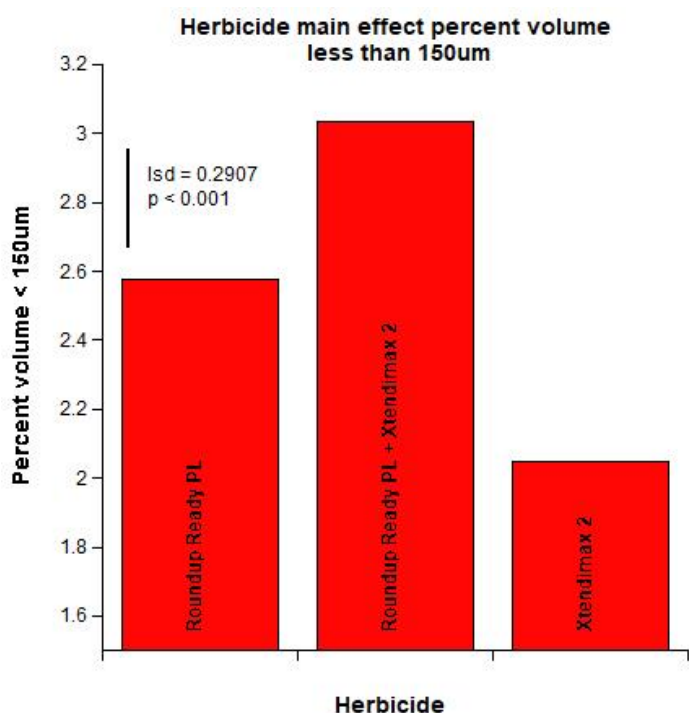
Each of the nozzles had significant differences Albuz AVI had the largest fraction followed by AI11003 then TTI60 Twin Jet. LSD = 0.2904 p < 0.001

Adjuvant	BS1000	LI700	No adjuvant	PCLL8
	3.232	1.934	2.522	2.532



BS1000 has a significant problem with finer droplet sizes. LI700 does not however it must be considered that as an effective adjuvant to spread herbicides, it is a very poor performer. It uses emulsified soy oils to coat particles which would affect its performance as an adjuvant which has been demonstrated. There is no difference between PCLL8 and No adjuvant and it is significantly better than BS1000 which means that it improves spreading and penetration without the penalty of increased production of finer droplets. LSD = 0.3353 p < 0.001

Herbicide	Roundup Ready PL	Roundup Ready PL + Xtendimax 2	Xtendimax 2
	2.578	3.037	2.050

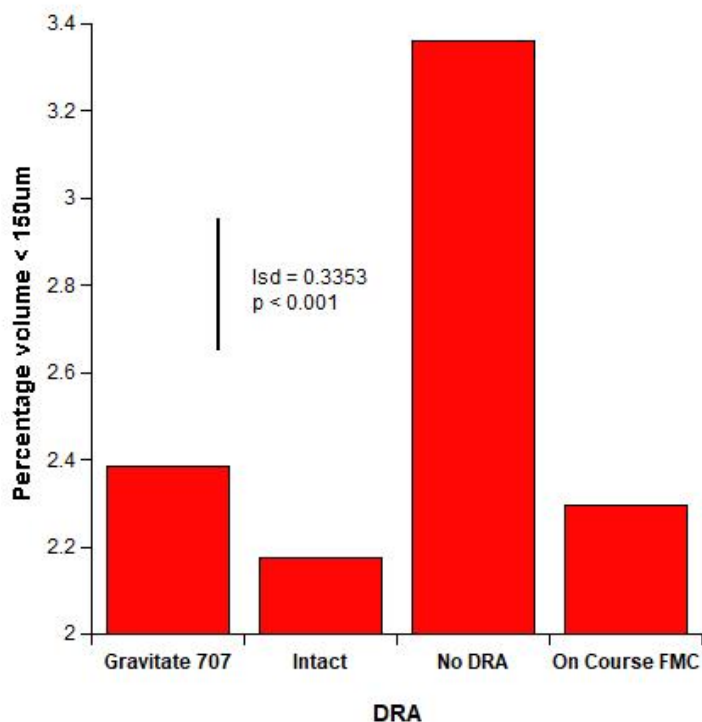


The combination of Roundup Ready PL + Xtendimax has a significant effect on the generation of the finer particles than the base herbicides themselves. LSD = 0.2904 p < 0.001

DRA	Gravitate 707	Intact	No DRA	On Course FMC
	2.387	2.174	3.362	2.296

DRA percentage volume less than 150um

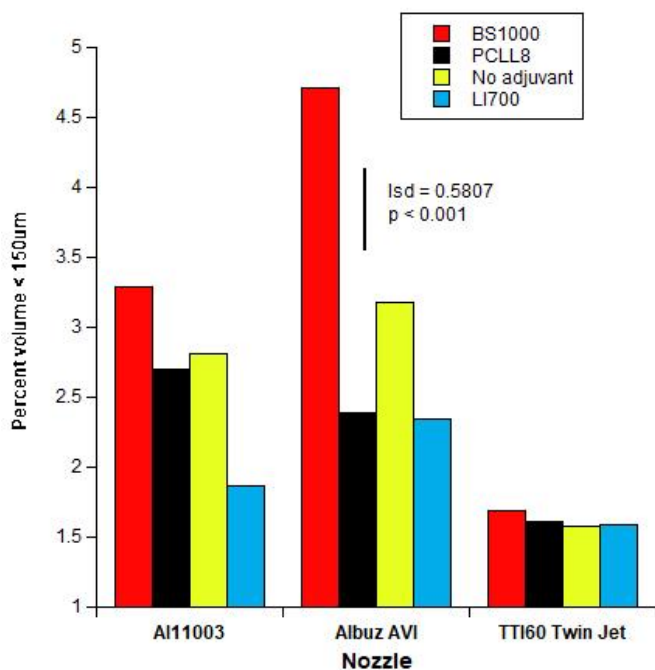
There was no significant difference between the three actual DRA's with only No DRA having significantly more finer particles than the rest. LSD = 0.3353 p <0.001



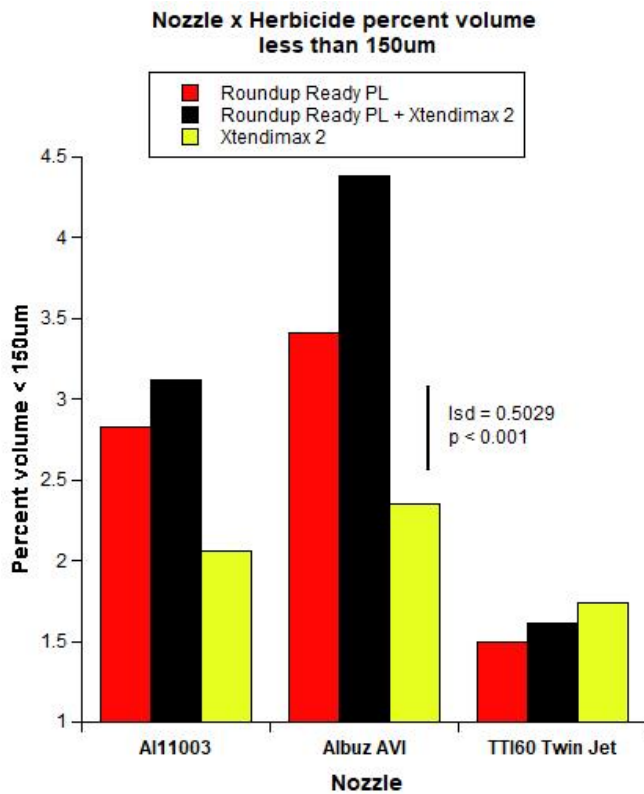
Nozzle x Adjuvant	BS1000	LI700	No adjuvant	PCLL8
AI11003	3.291	1.868	2.812	2.696
Albuz AVI	4.710	2.346	3.179	3.288
TTI60 Twin Jet	1.694	1.588	1.574	1.613

Nozzle x Adjuvant percentage volume less than 150um

There were no differences in adjuvants with the TTI60 nozzle however with the other two nozzles, BS1000 had the largest volume of finer droplets <150um. LI700 had the smallest fraction for reasons given above, hence the significant interaction. There was no difference between PCLL8 and No adjuvant. LSD = 0.5807 p <0.001

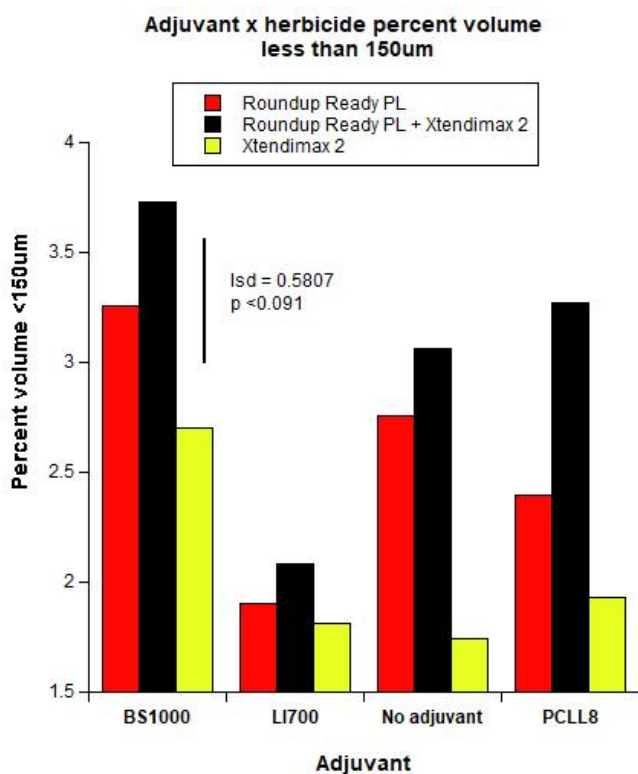


Nozzle x Herbicide	Roundup Ready PL	Roundup Ready PL + Xtendimax 2	Xtendimax 2
AI11003	2.826	3.118	2.056
Albuz AVI	3.407	4.383	2.352
TTI60 Twin Jet	1.500	1.611	1.740



With the AI11003 nozzle the Roundup combinations had significantly higher volumes than Xtendimax 2 and with the Albuz AVI nozzles, all herbicides were significantly different i.e. the combination of Roundup Ready PL + Xtendimax was higher than Roundup Ready PL which in turn was higher than Xtendimax 2. There was no difference with the TTI60 nozzle. $LSD = 0.5029$ $p < 0.001$

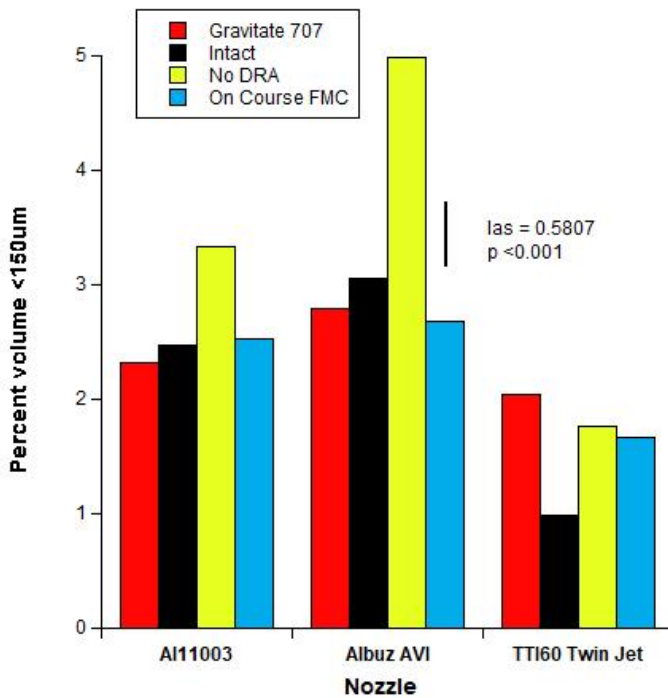
Adjuvant x Herbicide	Roundup Ready PL	Roundup Ready PL + Xtendimax 2	Xtendimax 2
BS1000	3.258	3.731	2.705
LI700	1.900	2.087	1.816
No adjuvant	2.757	3.063	1.744
PCLL8	2.395	3.268	1.933



While significant at the 90% confidence level there was no significant difference at the 95% level. $LSD = 0.5807$ $p = 0.091$

Nozzle x DRA	Gravitate 707	Intact	No DRA	On Course FMC
AI11003	2.323	2.477	3.339	2.527
Albuz AVI	2.797	3.058	4.981	2.687
TTI60 Twin Jet	2.040	0.988	1.766	1.674

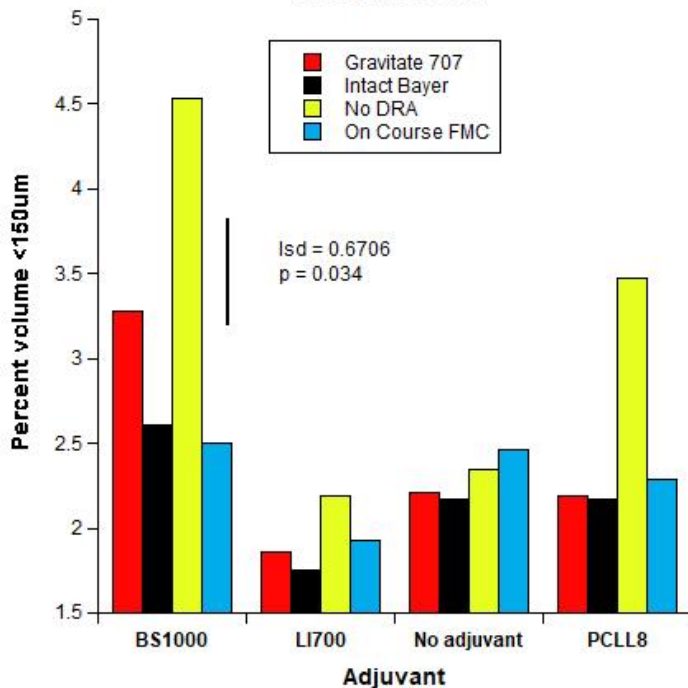
Nozzle x DRA percent volume less than 150um



Both nozzle type and DRA have an effect on the volume of particles <150um. With the TTI60 Twin Jet nozzle, Intact had significantly lower volumes than all of the other DRA treatments, which in turn were not significantly different to each other including the No DRA treatment. With the other two nozzles only the No DRA treatment was significantly different to the other DRA treatments. LSD = 0.5807 p < 0.001

Adjuvant x DRA	Gravitate 707	Intact	No DRA	On Course FMC
BS1000	3.283	2.607	4.531	2.506
LI700	1.862	1.750	2.195	1.929
No adjuvant	2.210	2.170	3.247	2.459
PCLL8	2.192	2.170	3.476	2.291

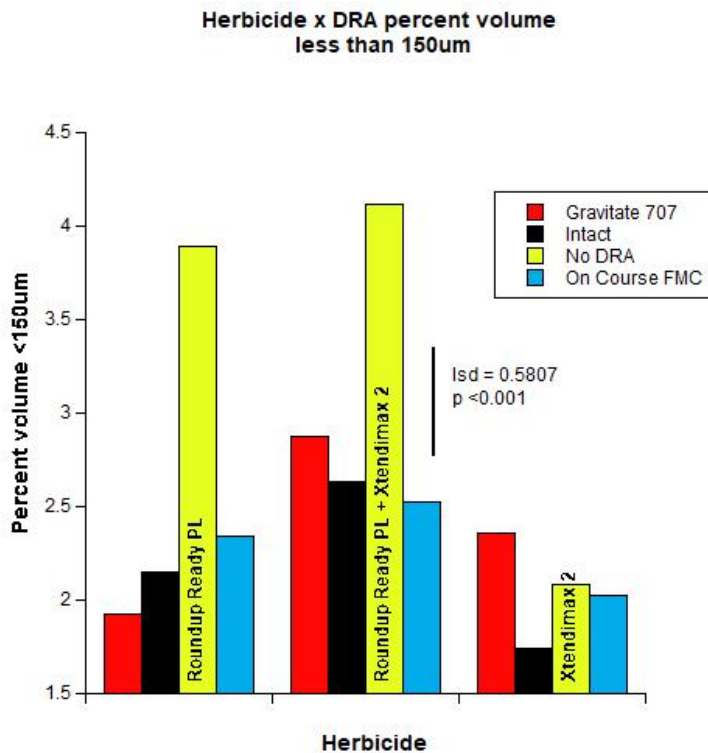
Adjuvant x DRA percent volume less than 150um



With BS1000, No DRA and Gravitate 707 had significantly higher droplet volumes than Intact and On Course FMC. With LI700 and No adjuvant, there was no significant difference between all DRA treatments. With PCLL8, No DRA was significantly higher than the other DRA treatments. Note that there was no difference in DRA treatments between No adjuvant and PCLL8 LSD = 0.6706 p = 0.034

Herbicide x DRA

	Gravitate 707	Intact	No DRA	On Course FMC
Roundup Ready PL	1.926	2.150	3.890	2.344
Roundup Ready PL + Xtendimax 2	2.878	2.635	4.115	2.522
Xtendimax 2	2.356	1.738	2.082	2.022



With Roundup Ready PL and Roundup Ready PL + Xtendimax 2 the No DRA treatment had significantly higher droplet volumes <150um than all of the other DRA treatments. With Xtendimax 2 only with Intact was there a significant reduction in the volume of particles <150um. LSD = 0.5807 $p < 0.001$

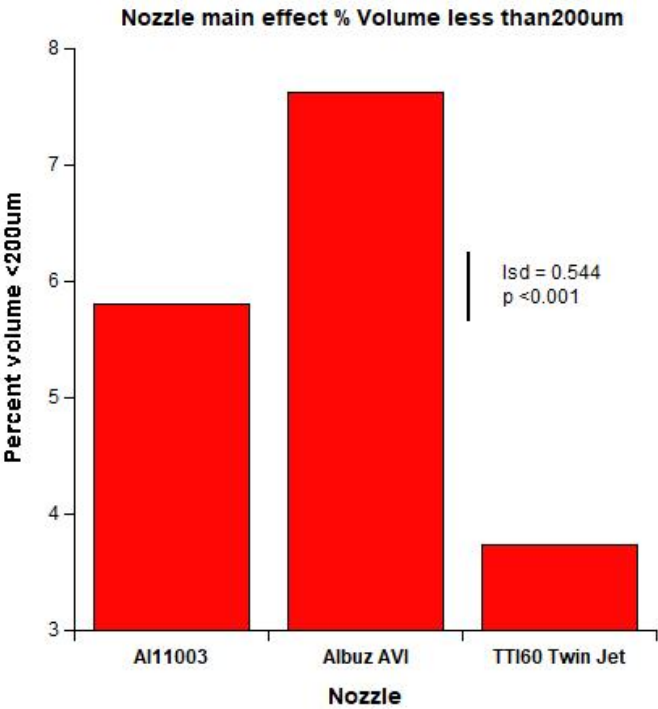
Analysis of variance All data**Variate: %V_200_/_Average (Percentage of Volume <200µm)**

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
Nozzle	2	365.559	182.779	101.53	<.001
Adjuvant	3	104.930	34.977	19.43	<.001
Herbicide	2	105.695	52.848	29.36	<.001
DRA	3	166.403	55.468	30.81	<.001
Nozzle.Adjuvant	6	59.156	9.859	5.48	<.001
Nozzle.Herbicide	4	83.536	20.884	11.60	<.001
Adjuvant.Herbicide	6	18.298	3.050	1.69	0.131
Nozzle.DRA	6	77.608	12.935	7.18	<.001
Adjuvant.DRA	9	26.879	2.987	1.66	0.110
Herbicide.DRA	6	67.321	11.220	6.23	<.001
Residual	96	172.825	1.800		
Total	143	1248.208			

Tables of means**Variate: %V_200_/_Average**

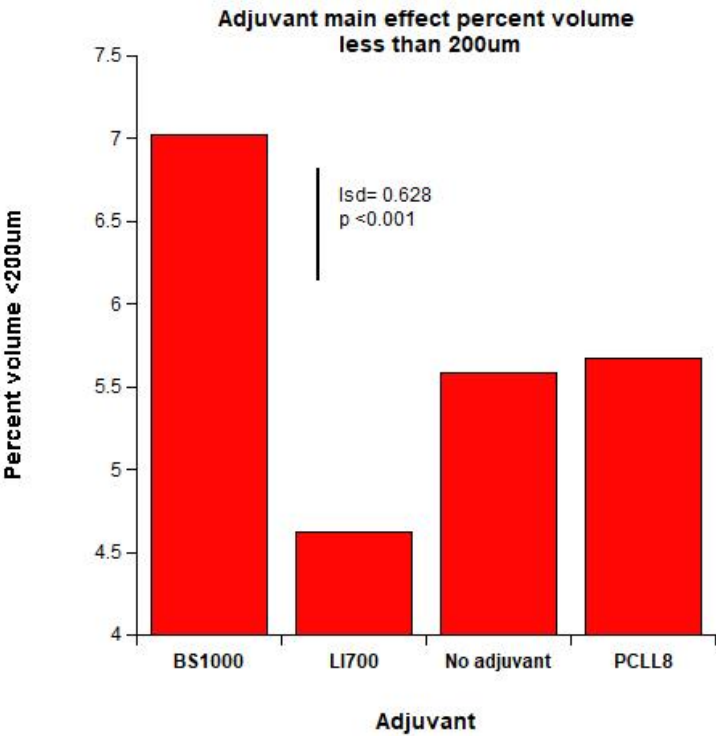
Grand mean 5.72

Nozzle	AI11003	Albuz AVI	TTI60 Twin Jet
	5.80	7.63	3.73



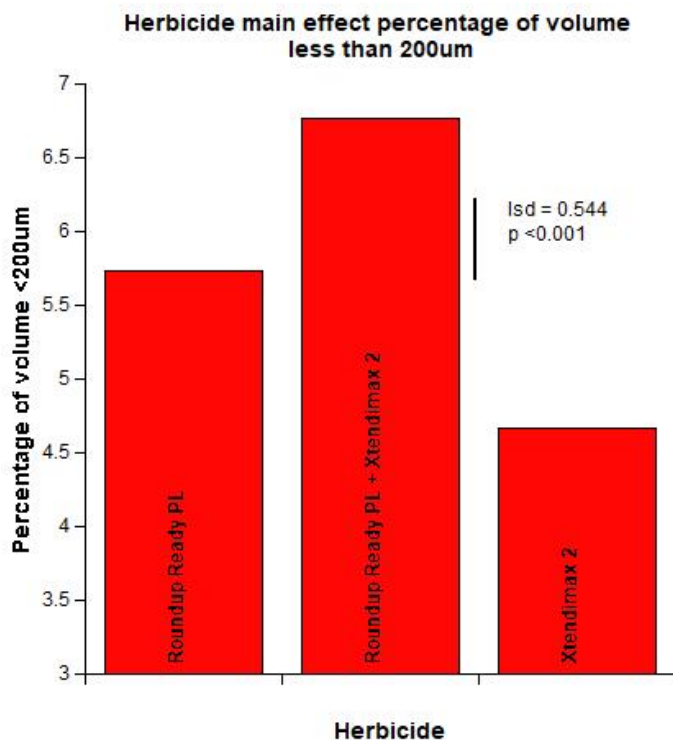
The TTI60 Twin Jet had the lowest volume of spray <200 um. Both of the others were significantly higher with Albuz AVI nozzle being the highest. LSD = 0.544 p <0.001

Adjuvant	BS1000	LI700	No adjuvant	PCLL8
	7.02	4.62	5.59	5.67



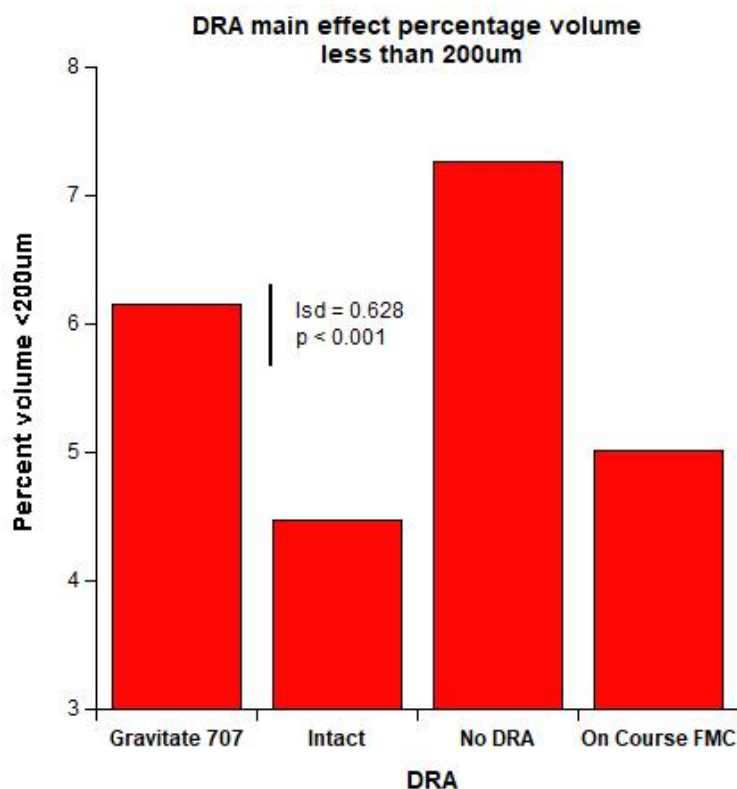
LI700 had the least volume, BS1000 had the most and PCLL8 was no different than with No adjuvant but had a significantly lower volume than BS1000. LI700 is an ineffective adjuvant as far as spreading and penetrating of herbicides due to the soy oil emulsion used to minimise small droplets leading to poor spreading and penetration. This is basis fluid physics. LSD = 0.628 p <0.001

Herbicide	Roundup Ready PL	Roundup Ready PL + Xtendimax 2	Xtendimax 2
	5.73	6.77	4.67



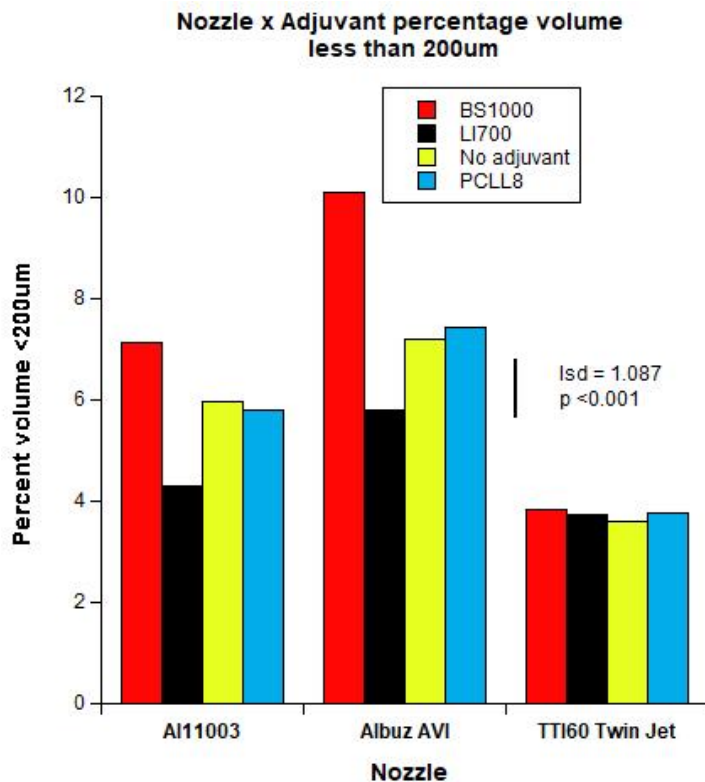
As shown before with spray droplet size the combination of Roundup Ready PL and Xtendimax 2 has increased the volume of spray <200um and it is significantly higher than straight Roundup Ready PL. Xtendimax 2 has the lowest volume of all three herbicides. LSD = 0.544 p < 0.001

DRA	Gravitate 707	Intact	No DRA	On Course FMC
	6.15	4.47	7.26	5.02



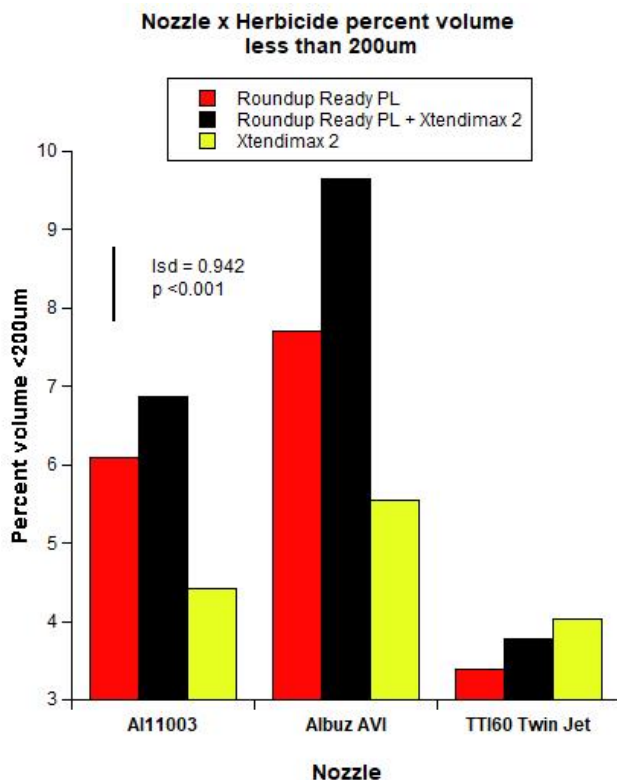
Intact and On Course FMC had the least volume <200um, there being no difference between Intact and On Course FMC. Gravitate 707 was significantly higher than Intact and On Course and No DRA was significantly higher than all the rest. LSD = 0.628 p < 0.001

Nozzle x Adjuvant	BS1000	LI700	No adjuvant	PCLL8
AI11003	7.14	4.30	5.97	5.80
Albuz AVI	10.09	5.81	7.21	7.43
TTI60 Twin Jet	3.82	3.75	3.59	3.78



With the TTI60 Twin jet nozzle there was no significant differences between any of the adjuvants. However with the other two, there were large and significant differences between the adjuvants, unsurprisingly BS1000 with both AI11003 and Albuz AVI had the largest volume <200um and LI700 the least. Again, there was no difference between PCLL8 and No adjuvant with any of the nozzles. With the first two nozzles, LI700 had the lowest volumes. LSD = 1.087 p <0.001

Nozzle x Herbicide	Roundup Ready PL	Roundup Ready PL + Xtendimax 2	Xtendimax 2
AI11003	6.10	6.87	4.43
Albuz AVI	7.70	9.66	5.54
TTI60 Twin Jet	3.39	3.77	4.04

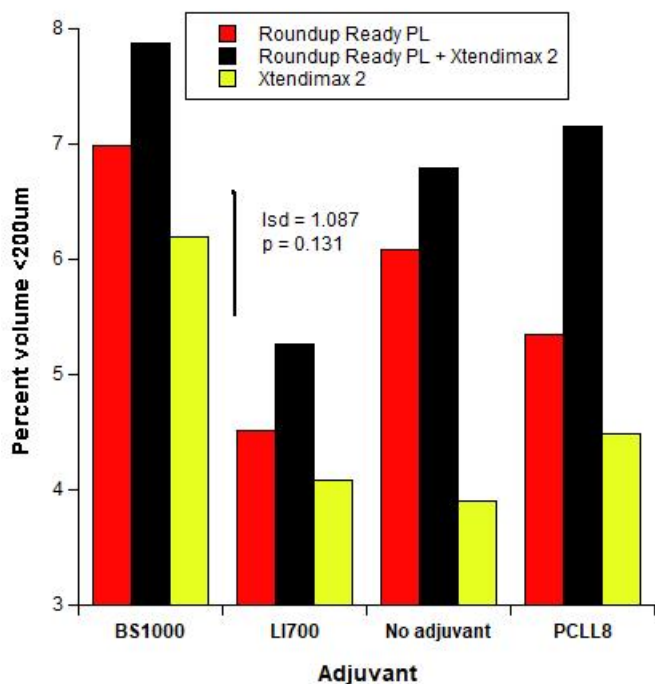


There was no significant difference between herbicides when using the TTI60 Twin Jet nozzle. With the other two nozzles, both herbicides containing Roundup had significantly higher volumes <200um than straight Xtendimax 2. LSD = 0.942 p <0.001

Adjuvant x Herbicide	Roundup Ready PL	Roundup Ready PL + Xtendimax 2	Xtendimax 2
BS1000	6.98	7.87	6.20
LI700	4.51	5.26	4.09
No adjuvant	6.08	6.79	3.91

PCLL8	5.35
7.16	4.48

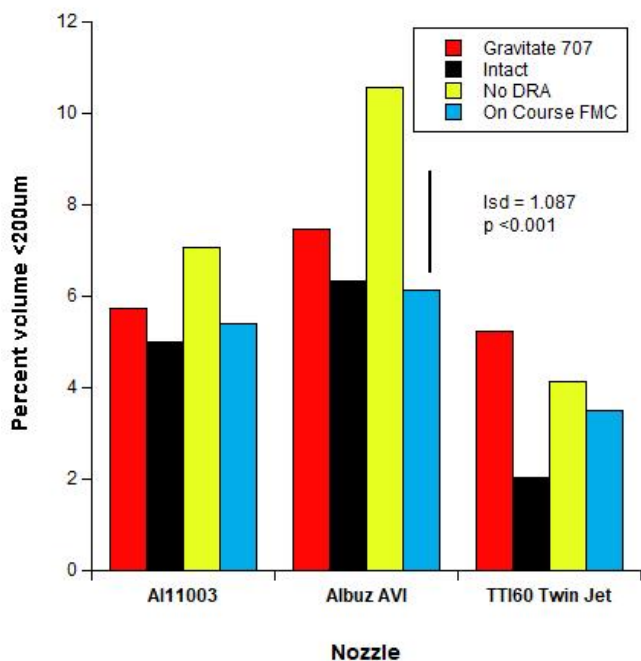
Adjuvant x herbicide percent volume less than 200um



There were no significant interactions between Adjuvant and Herbicide i.e. all of the difference between each herbicide were replicated with each adjuvant. $LSD = 1.087$
 $p = 0.131$

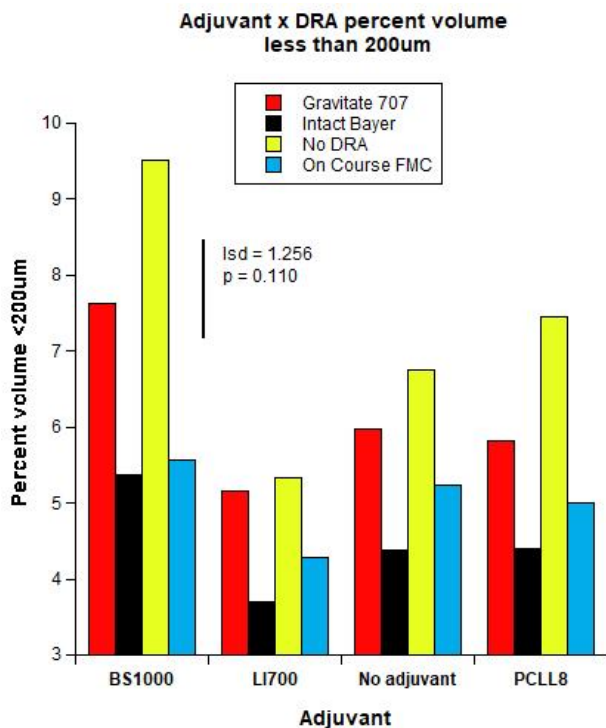
Nozzle x DRA	Gravitate 707	Intact	No DRA	On Course FMC
AI11003	5.72	5.01	7.08	5.40
Albuz AVI	7.47	6.34	10.57	6.15
TTI60 Twin Jet	5.25	2.04	4.14	3.51

Nozzle x DRA percent volume less than 200um



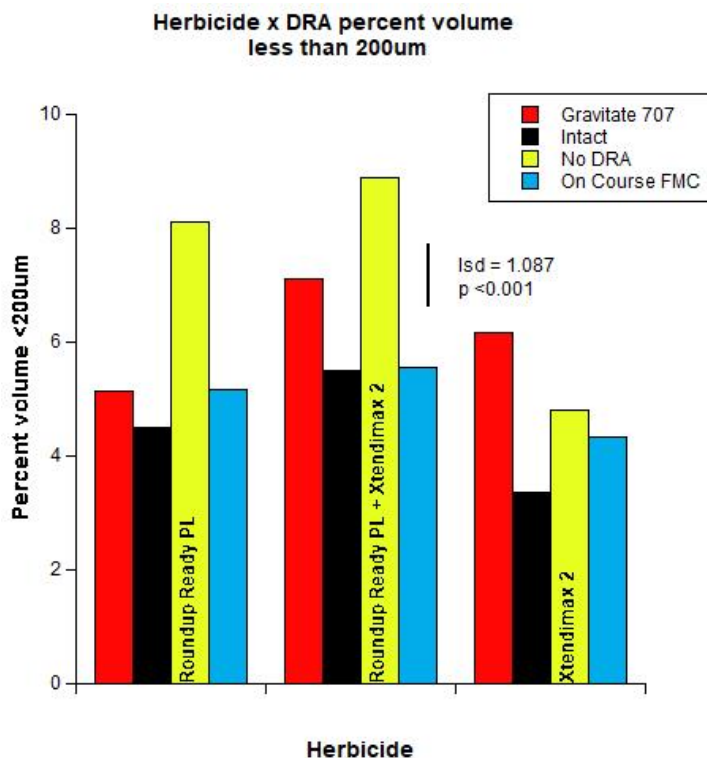
The combination of TTI60 Twin Jet nozzle and Intact was significantly better than the rest having a lower volume of <200um sized droplets. With the exception of the No DRA treatment on the Albuz AVI nozzle both the AI11003 and Albuz AVI nozzles with all of the DRA's were insignificantly different. With Gravitate 707 there was no difference between AI11003 and TTI60 Twin Jet nozzles but was with the Albuz AVI nozzle. This was one of the few times where the performance of the TTI60 Twin Jet nozzle was not better than the rest in terms of droplet size. $LSD = 1.087$ $p < 0.001$

Adjuvant x DRA	Gravitate 707	Intact	No DRA	On Course FMC
BS1000	7.62	5.38	9.51	5.56
LI700	5.16	3.70	5.33	4.28
No adjuvant	5.98	4.39	6.76	5.24
PCLL8	5.82	4.40	7.45	5.00



There were no significant interactions between Adjuvant and DRA, in other words there was no change in the order of the differences. Obviously the main effects graphs of Adjuvant and DRA will show the significant differences. $LSD = 1.256$ $p = 0.110$.

Herbicide x DRA	Gravitate 707	Intact	No DRA	On Course FMC
Roundup Ready PL	5.15	4.51	8.10	5.16
Roundup Ready PL + Xtendimax 2	7.11	5.51	8.89	5.57
Xtendimax 2	6.18	3.37	4.80	4.33



With Roundup Ready PL and Roundup Ready PL + Xtendimax 2 there was a higher volume of particles <200um with NO DRA than with all of the other DRA's, which were insignificantly different. Whereas with Xtendimax 2 it was the other way around i.e. Gravitate 707 had the largest volume hence the interaction. $LSD = 1.087$ $p < 0.001$

Analysis of variance All data

Variate: %V_1000_%_Average (Percentage volume > 1000um)

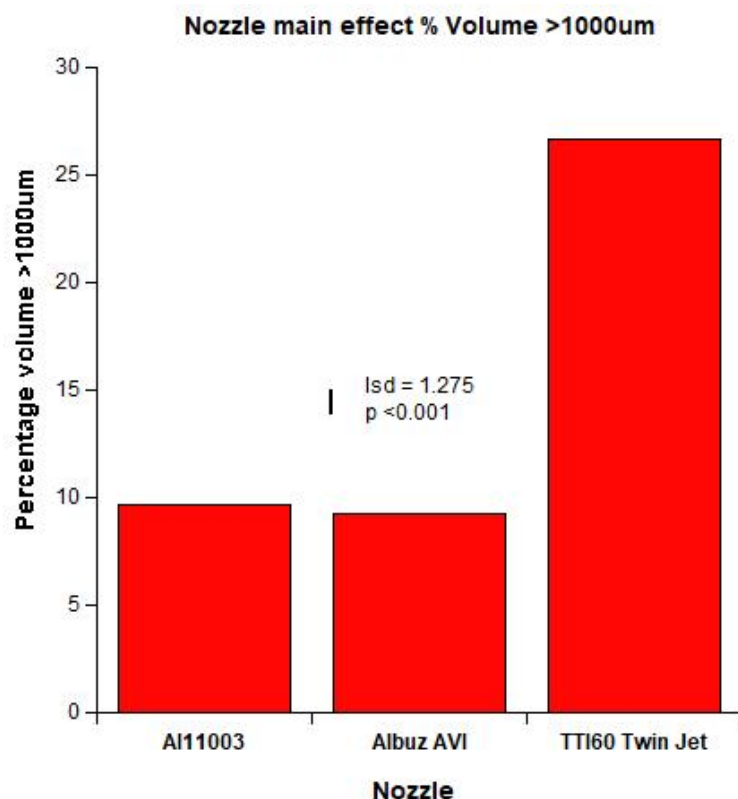
Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
Nozzle	2	9456.839	4728.420	477.60	<.001
Adjuvant	3	98.725	32.908	3.32	0.023
Herbicide	2	418.675	209.337	21.14	<.001
DRA	3	4764.992	1588.331	160.43	<.001
Nozzle.Adjuvant	6	154.427	25.738	2.60	0.022
Nozzle.Herbicide	4	244.524	61.131	6.17	<.001
Adjuvant.Herbicide	6	287.928	47.988	4.85	<.001
Nozzle.DRA	6	1241.983	206.997	20.91	<.001
Adjuvant.DRA	9	98.917	10.991	1.11	0.363
Herbicide.DRA	6	144.130	24.022	2.43	0.032
Residual	96	950.443	9.900		
Total	143	17861.583			

Tables of means

Variate: %V_1000_%_Average

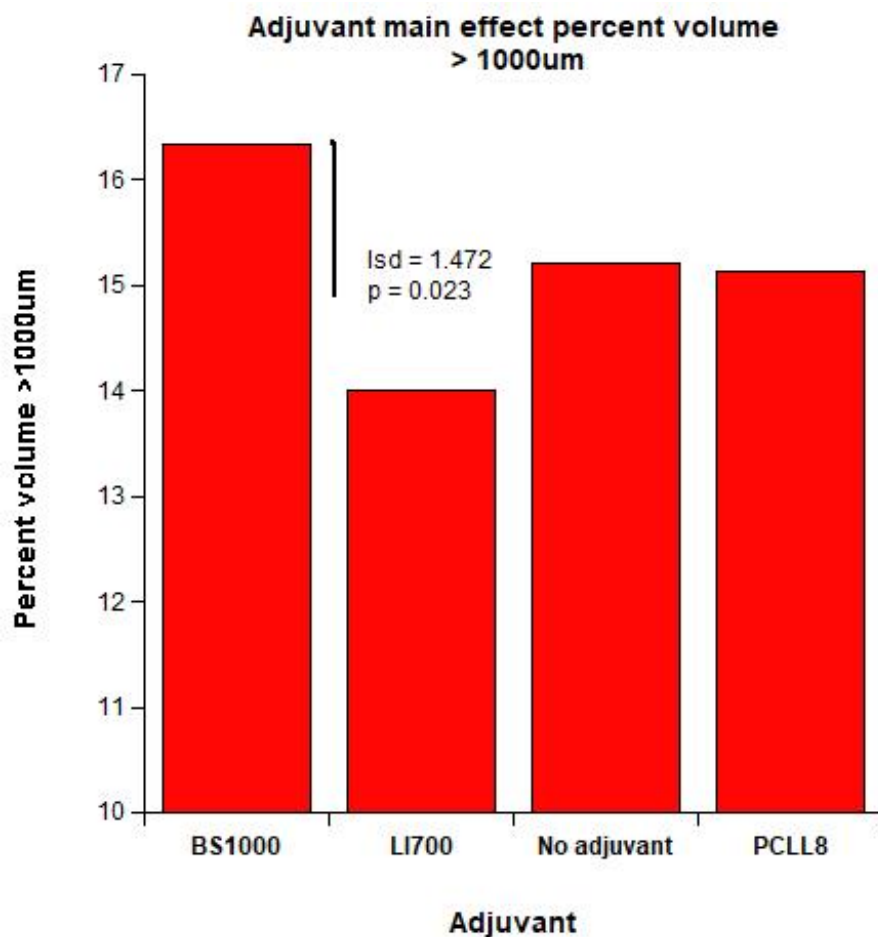
Grand mean 15.17

Nozzle	AI11003	Albuz AVI	TTI60 Twin Jet
	9.63	9.26	26.63



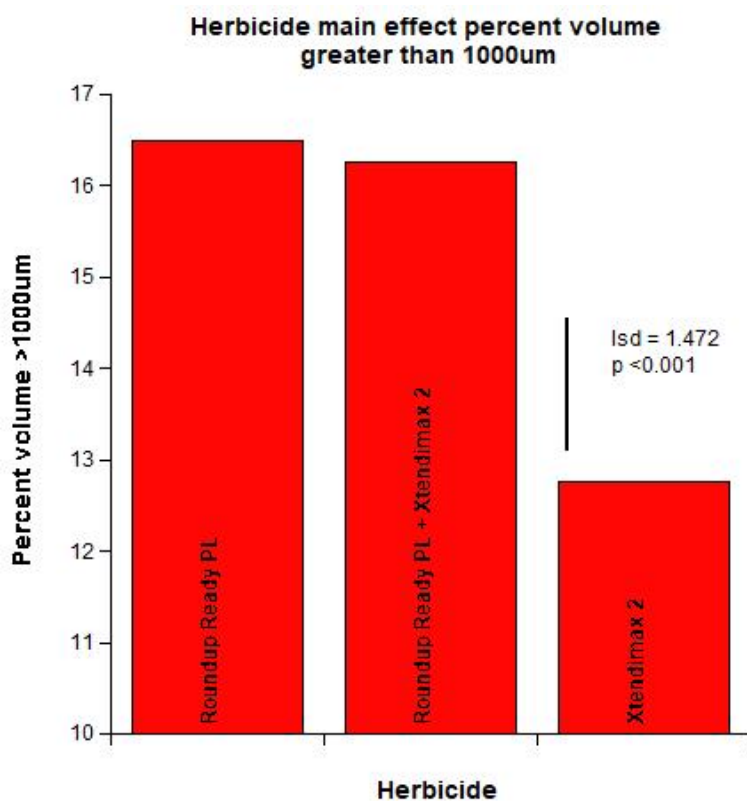
There was no difference between AI11003 and Albuz AVI however there was a huge increase with the TTI60 Twin Jet nozzle. While this nozzle is supposedly used to reduce finer spray droplets, the problem of large droplets rolling off the foliage must be considered. With this nozzle, over one-quarter of the spray volume could be wasted. $LSD = 1.275$ $p < 0.001$

Adjuvant	BS1000	LI700	No adjuvant	PCLL8
	16.34	14.00	15.22	15.14



LI700 had the lowest volume of spray droplets >1000um than all of the other adjuvants. There was no significant difference between the other three including PCLL8 and No adjuvant which were virtually identical. LSD = 1.472 p = 0.023

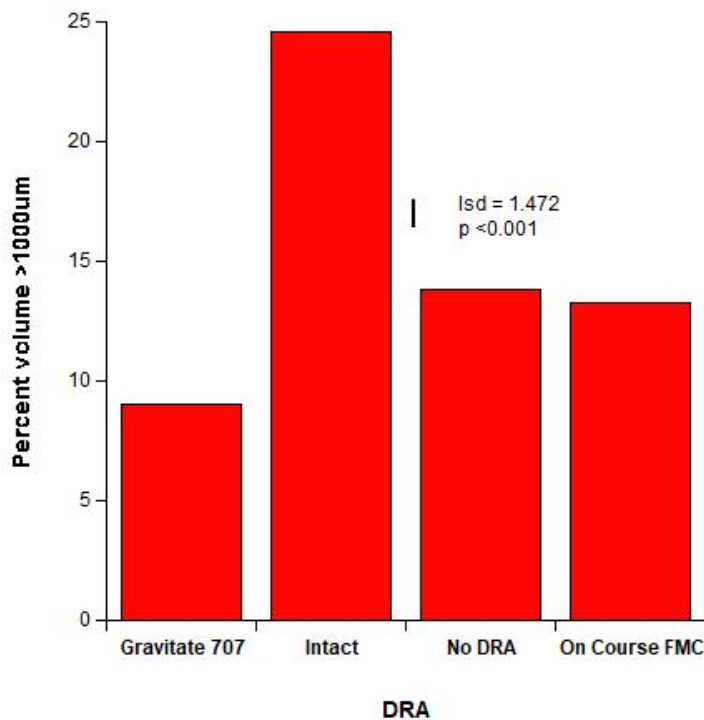
Herbicide	Roundup Ready PL	Roundup Ready PL + Xtendimax 2	Xtendimax 2
	16.49	16.27	12.77



Xtendimax 2 had a significantly lower volume of spray droplets >1000um than both of the Roundup formulations. LSD = 1.472 p < 0.001

DRA	Gravitate 707	Intact	No DRA	On Course FMC
	9.01	24.60	13.81	13.27

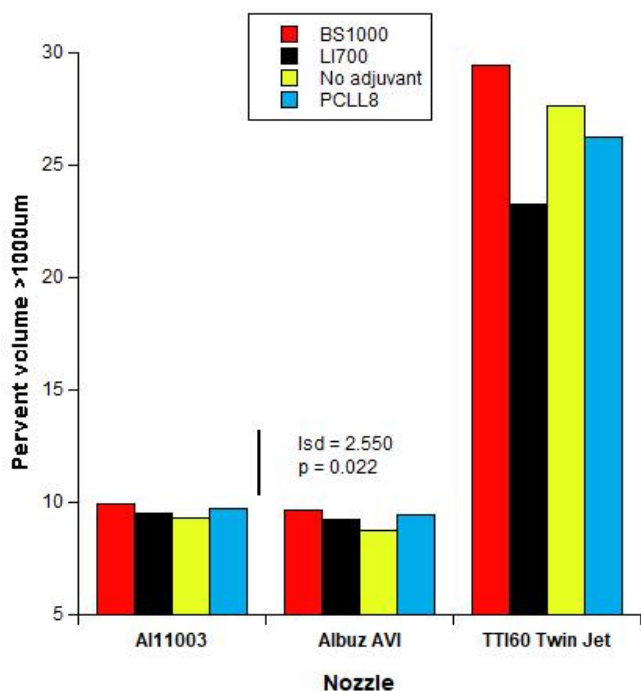
DRA main effect percent volume greater than 1000um



The results are clear, Intact has a big impact on droplet size, there is no difference between No DRA and On Course FMC. Gravitate 707 had the lowest volume of spray droplets >1000um. LSD = 1.472 p < 0.001

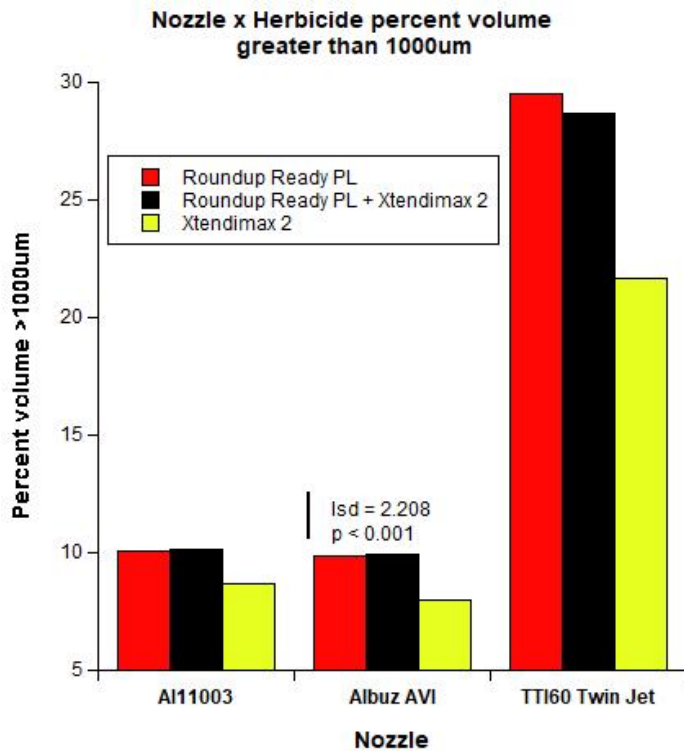
Nozzle x Adjuvant	BS1000	LI700	No adjuvant	PCLL8
AI11003	9.94	9.51	9.32	9.75
Albuz AVI	9.64	9.24	8.73	9.43
TTI60 Twin Jet	29.43	23.25	27.61	26.24

Nozzle x Adjuvant percentage volume greater than 1000um



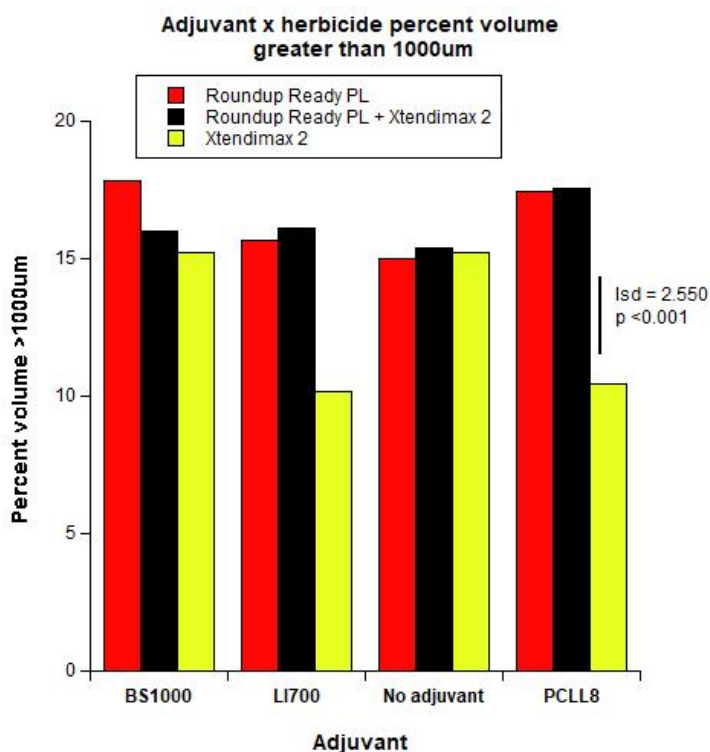
Excluding TTI60 Twin Jet there is no difference between any adjuvant with both AI11003 and Albuz AVI. The significant interaction being when using the TTI60 Twin Jet nozzle, BS1000 had a significantly greater volume than LI700 and PCLL8. LI700 with this nozzle had less volume than all of the other adjuvant treatments. There was no difference between No adjuvant and PCLL8 LSD = 2.550 p 0.022

Nozzle x Herbicide	Roundup Ready PL	Roundup Ready PL + Xtendimax 2	Xtendimax 2
AI11003	10.04	10.16	8.69
Albuz AVI	9.88	9.94	7.96
TTI60 Twin Jet	29.54	28.70	21.65



There were no significant differences with the AI11003 and the Albuz AVI nozzles. However the significant interactions were with the TTI60 Twin Jet nozzle where Xtendimax 2 had the smallest volume than both of the Roundup formulations. $LSD = 2.208$ $p < 0.001$

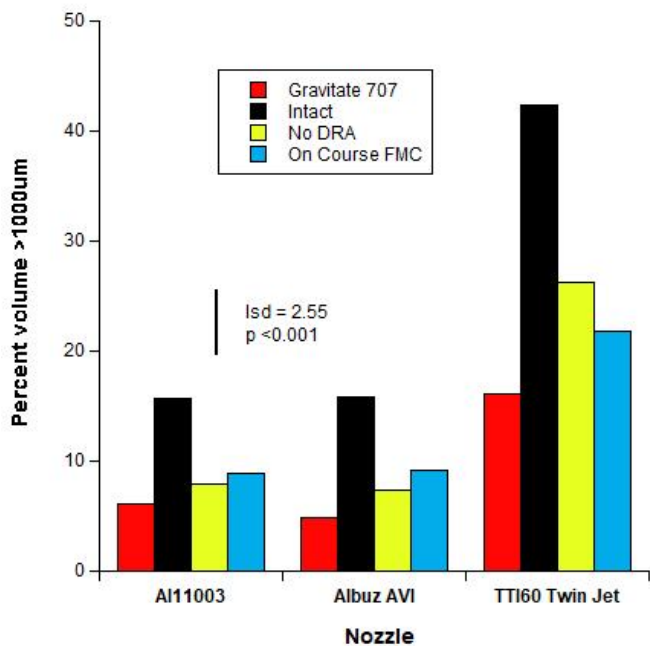
Adjuvant x Herbicide	Roundup Ready PL	Roundup Ready PL + Xtendimax 2	Xtendimax 2
BS1000	17.82	15.99	15.20
LI700	15.67	16.14	10.18
No adjuvant	15.03	15.38	15.25
PCLL8	17.43	17.55	10.43



With Roundup Ready PL there was a significant interaction (increase in volume) between BS1000 and No adjuvant. With Xtendimax 2 there were significant increases in volume between No adjuvant with BS1000 and PCLL8 with LI700. BS1000 is consistently showing a wider range of distribution of spray droplet size i.e. longer tail at both ends of the distribution curve. $LSD = 2.550$ $p < 0.001$

Nozzle x DRA	Gravitate 707	Intact	No DRA	On Course FMC
AI11003	6.13	15.66	7.87	8.85
Albuz AVI	4.81	15.78	7.30	9.15
TTI60 Twin Jet	16.10	42.37	26.26	21.80

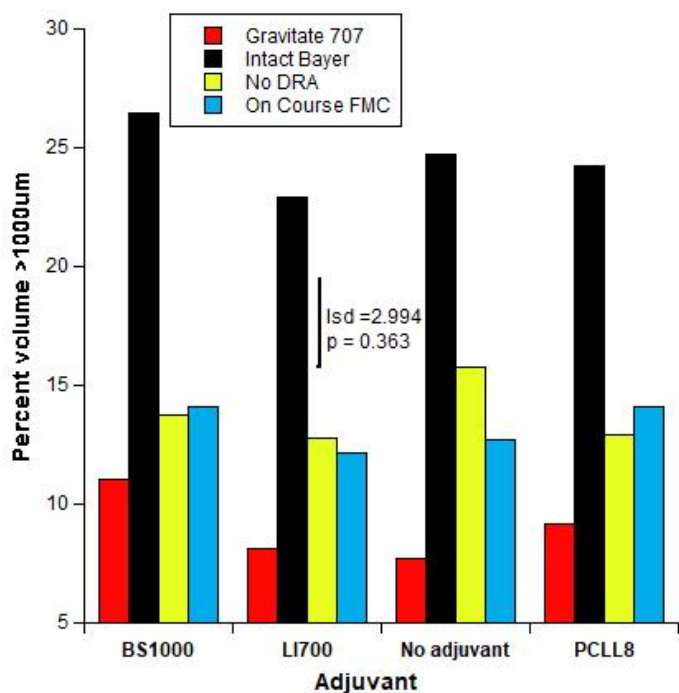
Nozzle x DRA percent volume greater than 1000um



Intact had the highest volume over all of the DRA's over all of the nozzles. The significant interaction being with the first two nozzles there was no significant difference between the other three DRA treatments. However, with the TTI60 Twin Jet nozzle, there was a significantly higher volume of larger droplets with all DRA's and between the Gravitate 707 which had the lowest, then On Course FMC and then No DRA as well as Intact. LSD = 2.550 p < 0.001

Adjuvant x DRA	Gravitate 707	Intact	No DRA	On Course FMC
BS1000	11.04	26.49	13.73	14.09
LI700	8.12	22.93	12.77	12.17
No adjuvant	7.68	24.72	15.80	12.68
PCLL8	9.20	24.27	12.95	14.13

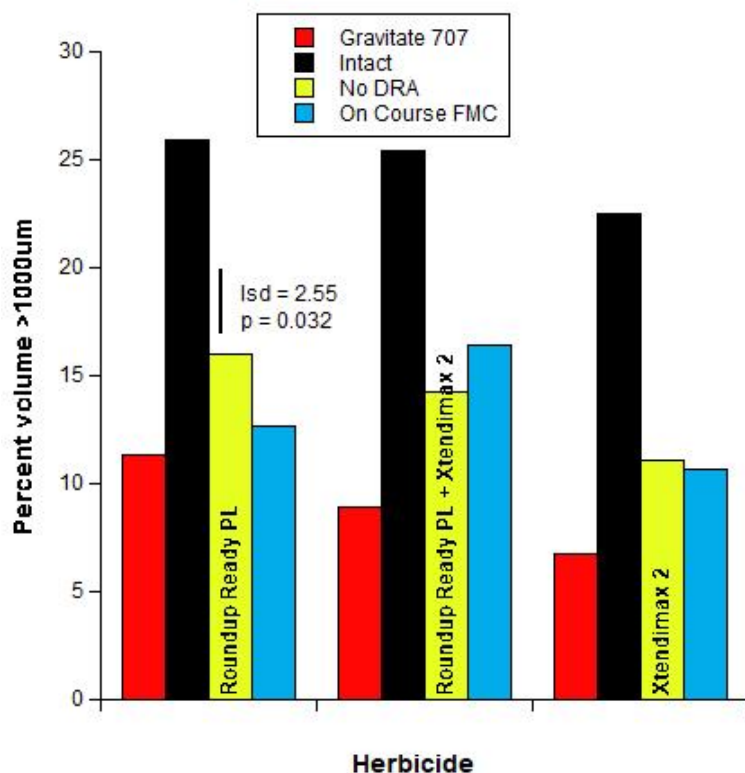
Adjuvant x DRA percent volume greater than 1000um



There were no significant interactions between Adjuvant and DRA. LSD = 2.994 p = 0.363 However looking at the main effects, clearly Intact had the greatest volume over all other DRA's over all adjuvants. Note again there was no significant difference between No adjuvant and PCLL8 with all of the DRA treatments.

Herbicide x DRA	Gravitate 707	Intact	No DRA	On Course FMC
Roundup Ready PL	11.37	25.89	16.03	12.67
Roundup Ready PL + Xtendimax 2	8.90	25.44	14.29	16.44
Xtendimax 2	6.77	22.48	11.12	10.69

Herbicide x DRA percent volume greater than 1000um



With Roundup Ready PL there were significant differences between three of the DRA treatments with volumes from greatest to least being Intact, No DRA, and On Course FMC. There was no difference between Gravitate 707 and On Course FMC with the Roundup formulation alone. However, with the other two herbicides there were no significant differences between No DRA and On Course FMC however these two DRA's were significantly higher than Gravitate 707 hence the significant interaction. Intact was higher than all other DRA's with all of the herbicides. LSD = 2.550 p = 0.032

Linear Regression Relating Dynamic Surface Tension to Average Size of Particles Lowest 10% Of Volume

AVI Albuz nozzle

Percentage variance accounted for is a summary of how much of the variability of the data can be explained by a fitted regression model. It is calculated as

$$100 \times (1 - (\text{Residual m.s.})/(\text{Total m.s.}))$$

When expressed as a proportion rather than a percentage, this statistic is called the *adjusted R²*; it has the advantage over the statistic *R²* (the squared coefficient of correlation, often used in regression) that it takes account of the number of parameters that have been fitted in the model. It along with the F pr. (p value) are the two key measures.

Regression Analysis

Response variate: Dv_10_um_Average (Average size of particles lowest 10% of volume)

Fitted terms: Constant, DST20 (Dynamic Surface Tension at 20 ms)

Summary of analysis

	d.f.	s.s.	m.s.	v.r.	F pr.
Regression	1	17806.	17805.6	35.84	<.001
Residual	46	22852.	496.8		

Total 47 40658. 865.1

Percentage variance accounted for 42.6

Standard error of observations is estimated to be 22.3

*** Estimates of parameters ***

	estimate	s.e.	t(46)	t pr.
Constant	87.6	23.1	3.79	<.001
DST20	2.945	0.492	5.99	<.001

Regression Analysis

Response variate: Dv_10_um_Average (Average size of particles lowest 10% of volume)

Fitted terms: Constant, DST40 (Dynamic Surface Tension at 40 ms)

*** Summary of analysis ***

	d.f.	s.s.	m.s.	v.r.	F pr.
Regression	1	16173.	16172.5	30.38	<.001
Residual	46	24486.	532.3		
Total	47	40658.	865.1		

Percentage variance accounted for 38.5

Standard error of observations is estimated to be 23.1

* MESSAGE: The following units have high leverage:

Unit	Response	Leverage
2	257.3	0.343
5	257.4	0.106
26	274.9	0.211

*** Estimates of parameters ***

	estimate	s.e.	t(46)	t pr.
Constant	115.3	20.1	5.74	<.001
DST40	2.569	0.466	5.51	<.001

The explanatory variate DST 20 is slightly better predictor than DST 40 response variate however all it really states is that with this nozzle there is a significant relationship between both DST 20 and DST 40 for this variable $p < 0.001$.

AI11003 Nozzle

Percentage variance accounted for is a summary of how much of the variability of the data can be explained by a fitted regression model. It is calculated as

$$100 \times (1 - (\text{Residual m.s.})/(\text{Total m.s.}))$$

When expressed as a proportion rather than a percentage, this statistic is called the *adjusted R^2* ; it has the advantage over the statistic R^2 (the squared coefficient of correlation, often used in regression) that it takes account of the number of parameters that have been fitted in the model. It along with the F pr. (p value) are the two key measures.

Response variate: Dv_10_um_Average (Average size of particles lowest 10% of volume)

Fitted terms: Constant, DST20 (Dynamic Surface Tension at 20 ms)

Regression Analysis

Response variate: Dv_10_um_Average

Fitted terms: Constant, DST20

Summary of analysis

	d.f.	s.s.	m.s.	v.r.	F pr.
Regression	1	14316.	14316.0	33.95	<.001
Residual	46	19400.	421.7		
Total	47	33716.	717.4		

Percentage variance accounted for 41.2

Standard error of observations is estimated to be 20.5

Estimates of parameters

	estimate	s.e.	t(46)	t pr.
Constant	121.3	21.3	5.70	<.001
DST20	2.641	0.453	5.83	<.001

*** Summary of analysis ***

	d.f.	s.s.	m.s.	v.r.	F pr.
Regression	1	13201.	13200.5	29.60	<.001
Residual	46	20516.	446.0		
Total	47	33716.	717.4		

Percentage variance accounted for 37.8

Standard error of observations is estimated to be 21.1

*** Estimates of parameters ***

	estimate	s.e.	t(46)	t pr.
Constant	145.4	18.4	7.91	<.001
DST40	2.321	0.427	5.44	<.001

The explanatory variate DST 20 is slightly better predictor than DST 40 response variate however all it really states is that with this nozzle there is a significant relationship between both DST 20 and DST 40 for this variable $p < 0.001$.

This is almost identical to the regressions done with the AVI Albuz data set.

TTI60 Twin Jet Nozzle

Percentage variance accounted for is a summary of how much of the variability of the data can be explained by a fitted regression model. It is calculated as

$$100 \times (1 - (\text{Residual m.s.})/(\text{Total m.s.}))$$

When expressed as a proportion rather than a percentage, this statistic is called the *adjusted R^2* ; it has the advantage over the statistic R^2 (the squared coefficient of correlation, often used in regression) that it takes account of the number of parameters that have been fitted in the model. It along with the F pr. (p value) are the two key measures.

Response variate: Dv_10_um_Average (Average size of particles lowest 10% of volume)

Fitted terms: Constant, DST20 (Dynamic Surface Tension at 20 ms)

Regression Analysis

Response variate: Dv_10_um_Average

Fitted terms: Constant, DST20

Summary of analysis

	d.f.	s.s.	m.s.	v.r.	F pr.
Regression	1	7800.	7800.	3.46	0.069
Residual	46	103777.	2256.		
Total	47	111576.	2374.		

Percentage variance accounted for 5.0

Standard error of observations is estimated to be 47.5

There was no relationship at the 95% confidence level of DST at 20ms and the average size of particles in the lowest 10% of volume

Response variate: Dv_10_um_Average

Fitted terms: Constant, DST40

Summary of analysis

	d.f.	s.s.	m.s.	v.r.	F pr.
Regression	1	7870.	7870.	3.49	0.068
Residual	46	103706.	2254.		
Total	47	111576.	2374.		

Percentage variance accounted for 5.0

Standard error of observations is estimated to be 47.5

*** Estimates of parameters ***

	estimate	s.e.	t(46)	t pr.
Constant	217.9	41.3	5.27	<.001
DST40	1.792	0.959	1.87	0.068

There was no relationship at the 95% confidence level of DST at 40ms and the average size of particles in the lowest 10% of volume