CROP SCIENCE SOCIETY OF S.A. INCORPORATED

C/- WAITE CAMPUS
P.M.B No 1, GLEN OSMOND, SOUTH AUSTRALIA 5064

AABN: 68 746 893 290

NEWSLETTER No. 323 APRIL, 2019

EDITOR – Judy Rathjen, articles welcome; Ph: 0421183978

email: juditrat@yahoo.com

TREASURER – Subscriptions
Susan Fuss
gsfuss@bigpond.com
Ph: 0407 900 055

SECRETARY – Correspondence
Neil Wittwer
wittwer.neil@gmail.com
0422 057 715

Next Meeting	**'Getting Towards Seeding'**
Venue	**Richardson Theatre, Roseworthy Campus**
Date	**WEDNESDAY 27th MARCH**
Time	**7.30 pm**

Speakers:

Ben Jones (Precision Ag Specialist - Flurosat)
Flurosat - a proven satellite imagery platform to enhance on-farm decision making.

Melissa Mcallum (SARDI)
2018 Durum Agronomy trial results.

Kenton Porker (SARDI)
Tips for early sown wheat - getting to the nitty-gritty of it.

Newsletter:

- **Spray Patterns – Jorg Kitt**
- **Herbicide Residues from Summer Spraying – Courtney Peirce**
- **Compatibility of Fungicide Seed Coatings and Rhizobia – Judy Rathjen**

Efficacy, Adjuvants and EXTREMELY COARSE Spray Pattern

Jorg Kitt (Kitt Consulting)

Background

As of 3rd October 2018, the APVMA introduced new 2,4-D label instructions that came into effect immediately. Old labels have been suspended. Users of 2,4-D MUST comply with the new label instructions, even if they are using products with the old labels.

It is vital for the survival of 2,4-D that the agricultural industry is following the new Best Management Practice instructions. 2,4-D is a major factor for drift damage in sensitive crops and the new legislations is designed to minimize these drift incidents.

Spray quality

1) From now on it is **mandatory** to apply 2,4-D amine and ester products with a droplet size not smaller than VERY COARSE. Old label instructions stated to use a spray quality not smaller than COARSE.
2) Further more, from the 3rd October to the 15th April, when most of the 2,4-D sensitive crops are growing, the APVMA instructs that it is **advisory** to apply 2,4-D with a spray quality not smaller than EXTREMELY COARSE.

These new instructions have serious consequences for nozzle selection and application decisions. The most common nozzle type in Australia is a low-pressure air-induction type nozzle such as Teejet AIXR, TurboDrop AirMix, Hardi Minidrift or others. Generally, these nozzles are able to produce a COARSE spray quality. They were able to meet the old legal requirements for 2,4-D applications but are not able to meet the new criteria to produce at least a VERY COARSE spray quality, unless the line pressure is dropped to a level where efficacy will be compromised.

As a starting point, to fulfil the new requirements, farmers have to look at high-pressure air-induction nozzles such as a Teejet AI, agrotop TurboDrop, Hardi Injet or others. They should run on pressures at or above 4 bar. But even those nozzles will generally not be able to meet the advisory requirements to spray with an EXTREMELY or ULTRA COARSE spray quality from October to April unless the pressure is dropped so low that droplet production will be compromised. There are only few nozzle types that can produce droplets that size, for example the Teejet TTI or the TurboDrop XL-D.

What does this mean for efficacy?

The new regulations are mainly designed to avoid unwanted off-target drift. They are unlikely to effect efficacy on larger summer weeds such as melons or larger marshmallows. However, they are likely to reduce efficacy on smaller weeds such as fleabane seedlings, especially when stubbles interfere with the spray pattern. There are some good rules of thumb that have been mentioned lately in several publications. While not ideal for efficiency they will improve efficacy. Over the last years not much work has been undertaken in this area. This will undoubtable change this summer spraying season but until results are confirmed it it is good advice for farmers to follow the below recommendations.

1) **Increase in product rate**. Not a popular option but generally that is the number one measurement that has consistently increased efficacy in most trial work. After all, the most expensive spray is the one that has not worked.

2) **Increase in water rate**. If the nozzle produces fewer, bigger droplets the shotgun principle to increase the likelihood to hit small targets is compromised. More water means generally more droplets. Applicators should change their practise to use 100L/ha if they chase small weeds with an EXTREMELY COARSE spray quality.
3) **Decrease in speed**. If there are stubbles present a sprayer needs time to penetrate. Slower speeds increase the likelihood to hit relatively hidden targets. Again, not a popular approach but it also provides other benefits such as less dust production and less bounce of the boom which also could be used to lower the boom height. Speeds of 12-16 km/h would be a suggested optimum with a maximum of 18 km/h.

4) **The spray medium – use of adjuvants**. As usually, this is an overlooked aspect. Adjuvants can have a profound impact on spray quality and spray pattern, in both, positive as well as negative aspects. The spray medium interacts with different nozzle types in different ways.

   A) TTI. The Turbojet TTI is the most commonly used nozzle type in Australia to produce an EXTREMELY COARSE spray quality. It is a very robust nozzle in reducing the amount of driftable fines and can be used over a wide range of pressures. The principle of producing the spray fan is different to most other nozzles. Once the spray solution has left the output orifice it is thrown against an ambos type plastic part that directs the spray fan in an angle downwards. The spray sheet is basically broken up before the liquid leaves the nozzle. This spray sheet is the part where adjuvants have the greatest effect on. As a result, a TTI nozzle is not much affected by adjuvants. They will hardly produce more driftable fines, but they will not improve their spray pattern very much either.

   B) Others. For a long time the TTI had almost a monopoly to produce an EXTREMELY COARSE spray quality with the relatively low water rates that are used in Australia. With the introduction of new regulations in Australia and other parts of the world, such as the US, other nozzle manufacturers released their versions of nozzles capable of producing an EXTREMELY COARSE spray quality, for example the agrotop TurboDrop XL-D. These nozzles have generally a conventional flat fan that appears uninterrupted underneath the output orifice of the nozzle. That means they produce slightly more driftable fines compared to a TTI nozzle. However, this also means they can be manipulated with adjuvants to reduce the amount of driftable fines and at the same time optimise the spray patter on the ground. On the other hand they can also be counter productive by increasing the amount of driftable fines. The choice of the right adjuvant is important.

   C) Example. Below are some spray pattern on water sensitive water strips that were produced with a TTI and a TurboDrop XL-D nozzle, using water and a LI 700 solution at 100L/ha (Image 1 & 2). While the spray pattern of the TTI is not affected by the adjuvant the spray pattern of the TurboDrop XL-D has clearly improved, while at the same time the amount of driftable fines was reduced to levels as low or even lower than that of the TTI (observation only).

If you are not sure how to select nozzles for your set-up to meet new 2,4-D requirements look for expert advice. Even if your agronomist or machinery dealer does not know, he may point you in the right direction.

Think Positive

While the new 2,4-D instructions affect the efficiency of spray operations they have to be seen as a positive move. Buffer areas came down significantly to manageable distances. More importantly, drift incidences are likely to decrease which is vital to secure a future of 2,4-D for Australian farmers. Future research will allow Australian farmers soon to minimise the impact new regulations will have on efficiency.

Herbicide Residues from Summer Spraying: Are they an issue for crop growth?

Authors: Courtney Peirce[1], Kenton Porker[1] and Michael Moodie[2]
Research Team: Paul Swain[1], Wayne Reid[1], Mick Brady[2]
[1]SARDI Crop Sciences, Waite Campus, [2]Moodie Agronomy
Funded By: GRDC DAS00162-B
Project Title: Validation of the persistence of common residual herbicides being used across the low rainfall zone
Peer Review: Jason Emms (GRDC), Gordon Cumming (GRDC)
Key Words: *Herbicide residues, glyphosate, 2,4-D, low rainfall*

Key Messages

- Residues of glyphosate and its primary breakdown product AMPA were present in all plots including controls
- Wheat and barley early biomass, vigour and yield were not impacted by glyphosate or 2,4-D residues in the field
- Negative biomass and yield responses occurred only for 2,4-D treatments when label plant back recommendations were not adhered to. The lightest texture soil was more prone to crop damage
- Current summer spraying practices as recommended by label rates are unlikely to cause any significant crop damage in wheat, barley, lentils and lupins

Background

The acknowledged benefit of summer spraying of weeds to conserve soil moisture has led to growers asking questions about whether herbicide residues may be affecting biomass and early vigour of the following crop. This has been raised as a concern in the low rainfall regions with sandy soils where herbicide breakdown can be hampered by sporadic rainfall, low microbial activity and soils having a lower capacity to bind herbicides. Previous work in this area (Macdonald et al 2017; Rose et al 2018) has shown that most cropping soils have herbicide residues accumulating with glyphosate, its primary metabolite AMPA and 2,4-D among those herbicides detected most frequently. While the herbicides can be detected in the soil, there has been less work showing the link between residue concentrations and their effect on early vigour, biomass and yield. The aim of this work was to evaluate whether levels of glyphosate and 2,4-D amine residues in the soil measured at sowing will affect early biomass, vigour and yield of the subsequent crop grown.

About the trial

Field trials were conducted at three locations in the South Australia and Victorian Mallee: Lameroo, Cooke Plains and Mittyack (Table 1). Soils at each location were light textured sandy soils with low organic carbon (0.35-1.1%) and pH ranging from 6.3 to 7.1 (1:5 water). Rainfall prior to sowing was low for all sites with the majority falling in the two weeks prior to sowing. Annual rainfall for each site in 2018 was between the 5th and 10th percentile from long-term rainfall data.

At each location, the trial was set up to generate different levels of herbicide residues in the soils by applying a high rate (the equivalent of spraying summer weeds four times at label rates) in either summer (early to mid February depending on the site) or pre-sowing to create a concentration gradient. These rates were deliberately applied for research purposes to create high concentrations in the soil and are considered outside of best economically viable practice. We do not recommend applying such high rates under common practice and suggest all herbicide application rates should adhere to the label. Soil samples were taken for herbicide residue testing from the wheat plots the day before sowing.

Table 1: Location, sowing date and rainfall data for field trials. Rainfall data taken from the nearest Bureau of Meteorology Station with a complete dataset for 2018; rainfall data reported includes the amount recorded between the summer herbicide application and sowing, the growing season rainfall from sowing to harvest and the annual rainfall for 2018 with the long term median for the site in brackets.

Field Trial	GPS Coordinates	Rainfall Summer to Sowing (mm)	GSR (mm)	Annual Rainfall (mm)	Herbicide Application		Sowing Date
					Summer	Pre-sowing	
Lameroo	-35.2463, 140.3964	30.4	120.5	208.4 (308.9)	12th Feb	28th May	29th May
Cooke Plains	-35.3631, 139.6457	52.2	163.6	261.2 (364.2)	6th Feb	30th May	31st May
Mittyack	-35.1598, 142.5049	25.8	60.5	139.1 (297.2)	2nd Feb	2nd June	3rd June

Field trials were set up as a randomised complete block design with:

- 4 crops: lupins *cv. Mandelup*, lentils *cv. Jumbo 2*, wheat *cv. Scepter* and barley *cv. Spartacus CL*,
- 8 different herbicide treatments of unsprayed, Glyphosate 450 CT at equivalent to 4 x the label rate, 2,4-D amine 475 (i.e. Cobber 475 Herbicide or equivalent) at equivalent to 4 x the label rate and a mixture of both herbicides at the same rates applied either early summer (January or February depending on site) or the day before sowing. This approach had the added benefit of two unsprayed controls; one from the summer spray timing and another from the pre-sowing spray timing.
- 3 replicates per treatment.

Plots were monitored for weeds, pests and disease and sprayed as necessary. Measurements on each plot consisted of plant counts for establishment, NDVI and biomass cuts at GS30 or 6-8 weeks post sowing to assess early vigour and growth and harvest yield. Differences between treatments were analysed using analysis of variance (ANOVA) and multiple comparisons using Tukey's test ($p \leq 0.05$) with Genstat V19.1 Statistical Package.

Results & Discussion

Each of the wheat plots with the mixture herbicide treatment applied had 4 soil samples taken the day before sowing and bulked from the top 10cm which were analysed for glyphosate, AMPA its primary metabolite and 2,4-D amine residues. The residue profile at each site was different but all soils contained some background level of glyphosate, AMPA and 2,4-D (Figure 1). A single application of 2L ha^{-1} of glyphosate 450 would result in 0.9 kg of active ingredient (a.i.) ha^{-1} whereas a single application of 1.8L ha^{-1} of 2,4-D amine 475 would result in 0.855 kg a.i. ha^{-1}.

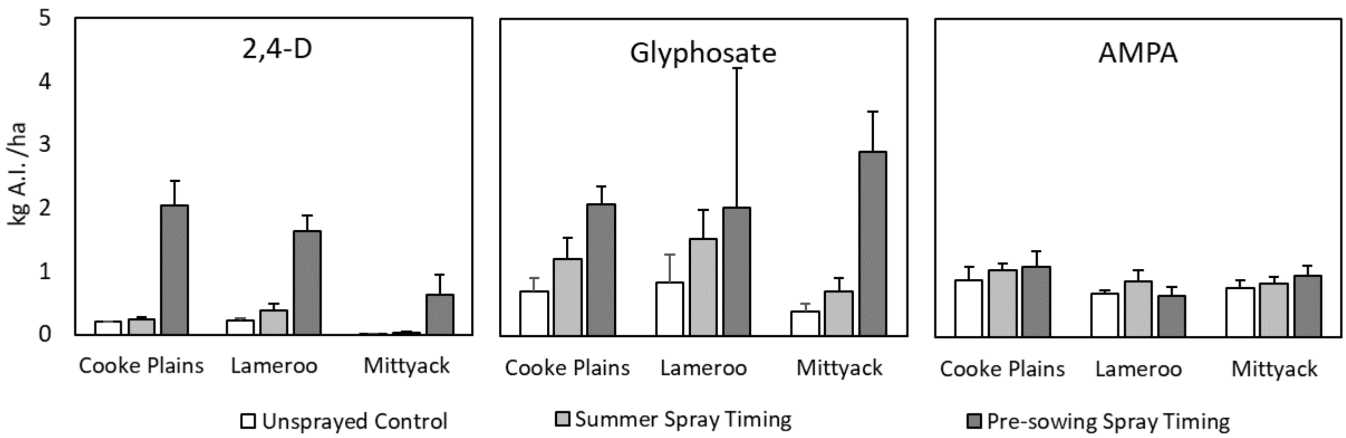


Figure 1: Herbicide residue concentrations detected at sowing in samples taken from the wheat control and herbicide mixture treated plots prior to sowing. Concentrations reported as kg of active ingredient per hectare assuming a bulk density of 1.6 g/cm^3 for all three soils (bulk density of these soils not measured).

2,4-D

Soil analysis determined that 2,4-D was present at higher concentrations only when it was applied the day prior to sowing whilst the summer application in all soils had degraded back to similar levels as the unsprayed control. In the case of 2,4-D, if you adhere to label plant back directions, (15mm of rain must fall prior to the commencement of the plant back period; 3 days for barley, 7 for wheat, 10 for lentils and 21 for lupins) concentrations in these soils were relatively low even in a season that was one of the hottest and driest autumns on record.

Glyphosate and AMPA

Glyphosate residues were present in all plots with highest levels for those applied just prior to sowing and summer application rates not completely degrading back to unsprayed control levels by the time of residue testing. The AMPA residues remained constant and did not seem to accumulate during the time from application to sowing suggesting minimal breakdown of glyphosate to AMPA.

Plant health responses:

At both the South Australian sites, there were no differences in plant density, NDVI or early biomass between herbicide treatments. Only differences existed between crop types (data not shown).

At Mittyack, both the mix and the 2,4-D treatment that was applied the day before immediately prior to sowing resulted in a reduction in lentil establishment from 95 to 10 and 18 plants m^{-2} respectively when compared to the control (ANOVA $p \leq 0.05$ l.s.d. 16 plants m^{-2}). At this site, the crops were sown the day after herbicide application, well short of the plant back period for lentils of 10 days after 15mm of rainfall. This was the only interaction between crop type and herbicide treatment for any of the results across the three sites.

At Mittyack there was also a significant reduction in early vigour due to herbicide treatment as measured by NDVI 6.5 weeks after sowing and early biomass as measured by a dry matter cut at GS30 (Table 2). This reduction in biomass was only in response to the 2,4-D amine application that occurred within a day of sowing and did not adhere to plant back periods for any of the crops.

For both South Australian sites, the only yield differences detected were for crop type (Table 3). Both lentils and lupins had very low yields at both these sites of less than 0.2 t ha^{-1}. The yields of the cereals fared better at both Lameroo and Cooke Plains but there were no yield differences at either site due to the herbicide treatments despite higher 2,4-D levels being measured in soil samples at both sites than measured for the Mittyack soil. At Mittyack, the yields for all crops were lower than the South Australian site yields. The very dry season at Mittyack resulted in all the lentil plots dying between biomass cuts at GS30 and harvest. All other crop types had significantly different yields. The biomass and NDVI results translated to a significant yield difference due to herbicide treatment. Once again, the 2,4-D and the mixture treatment applied pre-sowing resulted in a reduced yield compared to the unsprayed controls.

Table 2: *NDVI and Biomass at GS30 from Mittyack field site*

	NDVI	Biomass (t/ha)
Crop effect		
Lentils	0.164	0.14 a
Lupins	0.164	0.20 a
Barley	0.181	0.55 c
Wheat	0.179	0.40 b
l.s.d (p ≤ 0.05)	*n.s*	*0.07*
Herbicide Effect		
Summer Control	0.185 b	0.37 bc
Pre-sowing Control	0.190 b	0.39 c
Summer 2,4-D	0.181 b	0.44 c
Pre-sowing 2,4-D	0.137 a	0.19 a
Summer Glyphosate	0.194 b	0.31 abc
Pre-sowing Glyphosate	0.183 b	0.35 abc
Summer Mix	0.173 b	0.32 abc
Pre-sowing Mix	0.134 a	0.23 ab
l.s.d (p ≤ 0.05)	*0.02*	*0.10*

Table 3*: Yield (t/ha) for each site*

	Lameroo	Cooke Plains	Mittyack
Crop effect			
Lentils	0.07 a	0.10 a	*
Lupins	0.13 a	0.12 a	0.11 a
Barley	1.54 b	2.42 c	0.41 c
Wheat	1.69 b	1.96 b	0.29 b
l.s.d (p ≤ 0.05)	*0.26*	*0.17*	*0.06*
Herbicide Effect			
Summer Control	1.09	1.32	0.35 c
Pre-sowing Control	0.74	1.08	0.32 c
Summer 2,4-D	0.79	1.18	0.31 bc
Pre-sowing 2,4-D	0.89	0.96	0.17 ab
Summer Glyphosate	0.73	1.26	0.29 abc
Pre-sowing Glyphosate	1.07	1.15	0.31 bc
Summer Mix	0.83	1.15	0.25 abc
Pre-sowing Mix	0.73	1.10	0.15 a
l.s.d (p ≤ 0.05)	*n.s.*	*n.s.*	*0.09*

*no crop to harvest

Implications for commercial practice

Given the 2018 season was one of the hottest and driest autumns on record we expected little breakdown of crop herbicide. However, in these soil types we did not see any negative establishment, biomass or yield response from our summer spraying treatments at any of the sites.

Glyphosate and AMPA did not cause any significant negative plant health responses in any crop type, spraying time or location. The only negative responses were due to 2,4-D amine residues from spraying the day before sowing. This practice is not recommended and is outside of label plant back recommendations. It is clear that herbicide residues are going to be present in soils and may not completely breakdown within a season. If herbicide labels are adhered to and plant back recommendations are followed, they are unlikely to cause a problem in most soils however lighter textured soils, along with crops that have greater plant back recommendations such as legumes are likely to show the first signs of issues particularly in a dry season

Acknowledgements

The authors would like to acknowledge the Grains and Research Development Corporation (GRDC) for funding this work (Project No. DAS00162-B). Thanks to Rai Kookana and his technicians at CSIRO Waite Campus for herbicide residue testing.

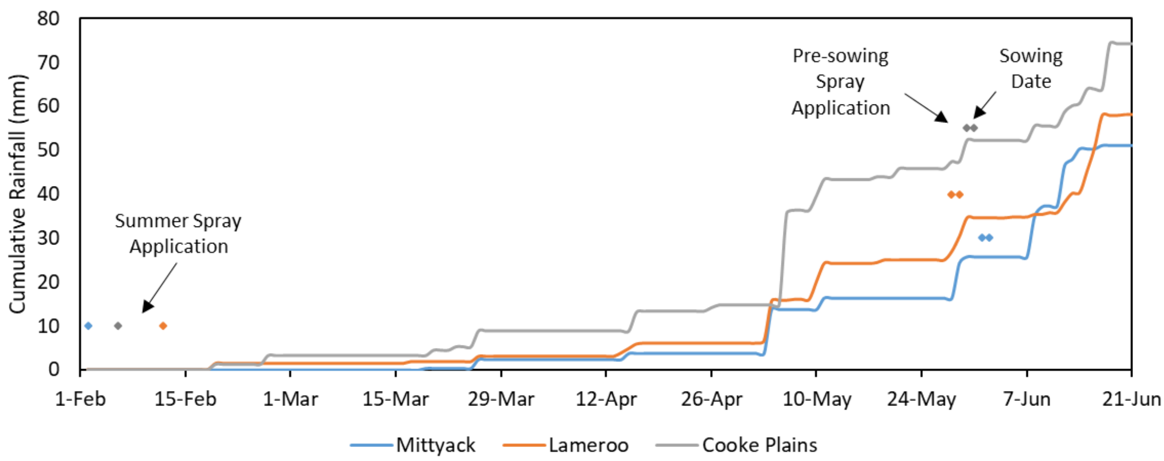
Special thanks to Robert Pocock, Kevin Roberts and Scott Anderson for allowing us to run our trials on their land at Lameroo, Cooke Plains and Mittyack.

References

Macdonald L, Kookana R, Wilhelm N, McBeath T, and Llewellyn R, (2017). Herbicide residues in sandy soils of the Southern region, MSF 2017 Compendium http://www.msfp.org.au/wp-content/uploads/Herbicide-residues-in-sandy-soils-Lynne-Macdonald-Full.pdf

Rose M, van Zwieten L, Zhang P, McGrath G, Seymour N, Scanlan C, and Rose T. (2018). Herbicide residues in soil – what is the scale and significance? GRDC Updates Adelaide https://grdc.com.au/resources-and-publications/grdc-update-papers/tab-content/grdc-update-papers/2019/02/herbicide-residues-in-soil-what-is-the-scale-and-significance

Appendix



Appendix 1: *Cumulative rainfall for all three field sites from the summer spray application to post crop sown. Timing of herbicide application and sowing date also shown on graph. Rainfall data taken from the nearest Bureau of Meteorology (BOM) Station with a complete dataset for 2018 (Mittyack BOM station 76069, Lameroo BOM station 25562, Cooke Plains BOM station 25502).*

Impact of fungicide seed coating on rhizobia survival and nodulation of pea plants

Judith Rathjen[1], Maarten Ryder[1], Thang Viet Lai[1] and Matthew Denton[1]
[1]University of Adelaide

Take home messages

- Nodulation was reduced when pea seeds were coated with P-PickelT fungicide before inoculation
- Reductions in rhizobia numbers on fungicide-coated seeds occurred very quickly, within 2 h, but the toxic effect of the fungicide continued after sowing
- Dry soil conditions are likely to have exacerbated fungicide toxicity to the rhizobia

Why do the trial?

Legumes are frequently inoculated with rhizobia at sowing, to improve nodulation and nitrogen fixation. Rhizobia can be supplied as peat, freeze-dried (liquid) or granular inoculant formulations. At sowing time, farmers often wish to apply different treatments together, to increase the efficiency of the sowing operation. In some cases, rhizobial inoculant is combined with the application of commonly used seed pesticides but this may result in toxic effects on the rhizobia. Given the importance of rhizobial survival to crop production, there is a need for independent data and guidelines to inform farmers about the potential reduction in legume nodulation and nitrogen fixation arising from the combination of various treatments with inoculants.

Laboratory data has showed that under sterile conditions, P Pickel T (PPT) is toxic to *Rhizobium leguminosarum* which nodulates pea, bean, lentil and vetch. This work also showed that peat may offer protection to the rhizobia compared to freeze-dried inoculant. The objective of this work was to determine the potential toxicity of the fungicide P-Pickel T (PPT) to rhizobia from a commercial inoculant (peat and freeze-dried) for field pea (*R. leguminosarum*, group F) in field conditions with low rhizobial background.

How was it done?

A field site with low background of field pea rhizobia was selected on Bruce Heddle's property, near MAC. The trial was a completely randomised design with three replications. Pea *cv.* Oura seeds were coated with the label recommendations for PPT, and then inoculated with either a commerical freeze-dried or peat formulation, again at commercial rates. Seed was sown immediately (0 h) or stored at room temperature in the dark for 24 h before sowing. Plots with no inoculation were also sown as controls (Nil). The plot sizes were 12 m x 1.8 m with 25 cm row spacing (6 rows), and an estimated plant density of 54 plants per m^2.

Before sowing, rhizobial counts from the inoculated and PPT treated/untreated seeds were performed to determine if there were adequate numbers. Seed samples (10 seeds) from all treatments (excluding Nil) were washed and diluted 10^{-1} to 10^{-5} in sterile water, and each dilution was plated drop-wise on sterile agar. After incubation, colonies were counted and rhizobia numbers per seed were calculated.

The trial was sown on June 30 and a nodulation assessment was conducted on September 20 (12 weeks after sowing). Plants and roots with soil were dug up in groups of 3 across the central 4 rows of the plot approximately 1 m apart, with a total of 12 plants collected from each plot. Soil was gently shaken from the roots which were then washed clean for nodule counts. Nodule fresh weight from each plot was also collected. On October 19 (16 weeks after sowing) shoot dry weight measurements were taken at peak biomass, and yield data was recorded after harvest. Nitrogen fixation measurements are in progress (N^{15} natural abundance method).

What happened?

Conditions were very dry (gravimetric water content 8 % w/w) and sowing only occurred late (June 30) due to low soil moisture. After sowing there was about 5 mm of rainfall over the following week. At nodulation sampling, it was visually easy to differentiate the well-nodulated plants from those with low nodulation, which were stunted and yellow. There was very little rain throughout the growing season (GSR 169 mm), which had a significant effect on yield and biomass production.

Figure 1 shows that there was a much lower number of nodules per plant grown from seed inoculated with freeze-dried rhizobia compared to peat formulation. Table 1 shows that rhizobial counts taken from the inoculated seeds before sowing verified that there were undetectable numbers of rhizobia on the seeds with freeze-dried inoculant which was stored for 24 h before sowing (data not shown). However, there were adequate (4.8 x 10^5 cfu / seed) populations of bacteria associated with seed treated with the peat and freeze-dried inoculant at 0 h (Figure 1). The peat and freeze-dried inoculant treatment which had been coated with PPT 24 h before sowing, showed a significant decline in rhizobia numbers.

Table 1: Rhizobial counts from seeds (10 seeds) prior to sowing

Treatment	Fungicide	Time (0 h)	Log_{10} cfu / seed
Peat	-	0	5.5
Peat	+	0	5.0
Peat	-	24	4.9
Peat	+	24	4.1
FD	-	0	4.7
FD	+	0	below detection
FD	-	24	below detection
FD	+	24	below detection

Peat = peat slurry inoculum, FD = freeze-dried inoculum, +/- fungicide coating and inoculated before sowing (0 h) or stored for 24 h before sowing.

Figure 1 shows that there was a negative effect of PPT on plant nodulation. Although plants treated with the peat inoculant treatments without fungicide had 72% greater nodules / plant compared to the Nil treatment, the nodule number was still relatively low. There was very low nodulation in the freeze-dried inoculant treatments both with and without the fungicide seed dressing, but a larger decrease in nodule number can be seen in the seed stored for 24 h before sowing, compared the seed which was sown immediately after inoculation.

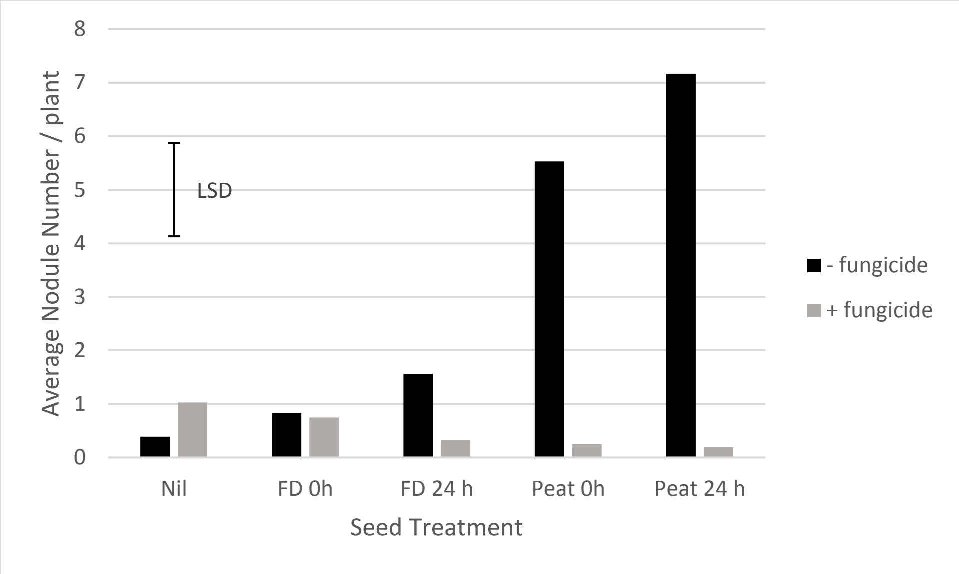


Figure 1: Effect of seed fungicide treatment PPT on average nodule number of plants from seed inoculated with freeze-dried or peat slurry at 0 h or 24 h before sowing

Nodule fresh weight per plant (Figure 2) was significantly correlated with the average nodule number per plant (r = 0.91, data not shown). Figure 2 shows a similar pattern to plant nodule number, with a decrease in nodule fresh weight in seed coated with PPT before inoculation. In particular, the plants had much lower nodule fresh weight in the PPT treatments compared to the no fungicide treatments. The fresh nodule weight was lower in the freeze-dried treatments than the peat inoculant, so there was not such a dramatic decrease when combined with the PPT seed dressing. The Nil treatment had only a few nodules, but these nodules had a high fresh weight.

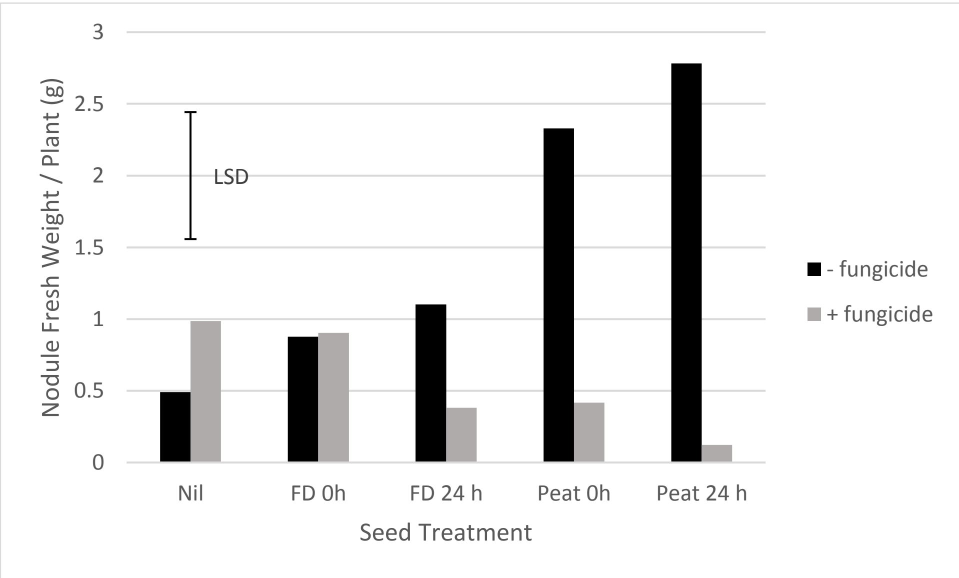


Figure 2: Effect of seed fungicide treatment PPT on nodule fresh weight of plants from seed inoculated with freeze-dried or peat slurry at 0 h or 24 h before sowing

What does this mean?

In vitro studies in the laboratory and nodulation experiments conducted under sterile conditions have shown that the fungicide PPT is toxic to some commercial strains of rhizobia. In this field trial, we aimed to determine if this same effect can be observed in a field situation with an active microbial community and a low background of rhizobia. The low number of nodules detected in the Nil treatment confirms that the field site had very low interference from background rhizobial populations (Figure 1). However, adequate nodulation for field pea on light soils is considered to be 20 nodules per plant, which was not achieved in this field trial (Drew et al., 2016)

For seed coated with the fungicide PPT and inoculated with a peat slurry, there was a decrease in rhizobial survival on the seed and subsequent plant nodulation. It has previously been recommended to sow coated and inoculated seed within 6 hours to avoid toxicity to the rhizobia (Drew et al., 2016, Table 5.4), however our results show that rhizobial survival on the seed decreased rapidly before sowing (less than 2 hours). With freeze-dried inoculant, nodulation was much reduced (78 to 85% less) compared to the peat formulation. Rhizobial survival on the seed was reduced, which resulted in fewer nodules without the presence of PPT.

Some of the plants with a low nodule number appeared to have much bigger nodules than the plants with more nodules, but this did not completely compensate for the loss of nodulation, as nodule fresh weight also declined in the presence of PPT. In general, the higher the nodule number and fresh weight per plant without fungicide, the greater the reduction with exposure to PPT.

The dry conditions at this site may have contributed to a the observed toxic effect of PPT, as the low soil moisture and rainfall means that the rhizobia are in contact with the fungicide longer than in a year of increased rainfall. Moisture stress during growth and development would also have contributed to inconsistent shoot weight and yield data, which was not correlated with nodulation measurements.

The substantial reduction in pea nodulation following exposure of the seed-applied rhizobia to PPT would be expected to also reduce nitrogen fixation. Data analysis is in progress; this is supported by field observation that poorly-nodulated plants were stunted and yellow.

The data suggest that in a season where conditions are likely to be stressful (eg moisture stress, low soil moisture levels), then the added stress of exposure to toxic fungicide can be quite detrimental to nodulation and N fixation. Best results were obtained with peat formulation which appears to have a protective effect on rhizobial survival. Separating the fungicide and rhizobia, eg by applying inoculant as liquid in furrow or as a granular formulation, may lead to avoidance of toxic interactions and adequate nodulation. It would be useful to test these options in the field.

Drew E, Herridge D, Ballard R, O'Hara G, Deaker R, Denton M, Yates R, Gemell G, Hartley E, Phillips L, Seymour N, Howieson J and Ballard N, 'Inoculating Legumes: A practical guide'. GRDC, July 2016

DON’T MISS!

22nd Australasian Weeds Conference 25 – 29 October 2020

Location: Adelaide Oval, Adelaide

In October 2020 the Weed Management Society South Australia will host the 22nd Australasian Weeds Conference. This biannual Australasian event comes to Adelaide once every 14 years, and is an opportunity not to be missed.

To be held at the iconic Adelaide Oval from 25 – 29 October 2020. Early enquiries can be sent through to **wmmsa01@hotmail.com**