UNFS UPDATE

Upper North Farming Systems Newsletter January 2017

UNFS website up and running

Ruth Sommerville

Wishing you all a wonderful start to 2017. The 2016 season is only just coming to a close for many, but hopefully the outcome has been worth the effort for you all. The prices of livestock and wool, and the long growing season for crops were highlights for the year.

As a group UNFS hit a lot of goals in 2017, not least of which is the new UNFS website. We showcased the website at the Members Expo in August and officially launched it in December with the video clip “Twas the night before Christmas - Harvest Edition”. The video was a little bit of fun, but with a good cause. As a new website, it is hard for people to find you. One way to get the UNFS website more “searchable” is to have people visit the site. The more people that visit the site, the higher up the google search list the website travels. The video and your visits to the site have listed the UNFS website on to the second page of the google search for both Upper North Farming Systems and UNFS. How do we get it to the first page you ask? Well we could pay...but the better way for a not-for profit group like ours is to encourage all of our members and supporters to search for us and visit our site. Can you help us out???

We’ve got some great events coming up in 2017, kick starting with 4 workshops over the next 6 weeks. On Tuesday the 31st of January the Ladies on the Land Group are holding a Communication Workshop run by Judy Wilkinson. Encourage the women in your families and enterprises to get along, Judy is a wealth of knowledge on this topic and the workshops are great fun. More details on page 6.

In February, UNFS has teamed up with the Northern and Yorke NRM Board and Greening Australia to run a series of Grassy Weed Workshops. These will look at your problem grassy weeds and some new and emerging weeds. Full details are still to be announced with a flier to be sent out in the next few weeks.

We’ve got a great line up of trials planned again this year. The SAGIT funded Time of Sowing Trial will continue with the results from 2016 to be available early February. The site in 2016 certainly experienced both heat and frost events, and the results look interesting so far. Quality testing will occur on sub-samples next week.

There will be a number of GRDC funded Stubble Demonstrations to visit again this year, with details to be finalized at the February and March committee meetings. There are a vast number of Stubble Management Guidelines nearing completion as we speak, so plenty of information and case studies coming your way to improve your productivity and profitability in a retained stubble system.

A GRDC funded Windrow Burning Project has started, with the collection of vast amounts of weed seeds from across the region. These will be sent to the lab for heat testing to determine how much heat they require to be no longer viable seed. The second component of this trial is testing how hot the windrows actually get. This is where we need your help. I am after 5 windrow burning paddocks to sample using an infra red head sensing gun. If you are planning on windrow burning (or whole paddock burning) paddocks prior to seeding this year please let me know and we can test how effective the burn is being in controlling your weed seeds.

Also In This Issue

Summer weed control needs to set up next season

Author: *Alistair Lawson—GRDC Groundcover—31/10/16*

Staying on top of weeds will be critical over the 2016-17 summer to preserve stored soil moisture from the above-average winter rainfall and any rainfall over late spring and summer.

In noting this, University of Adelaide weeds researcher Dr Gurjeet Gill says GRDC-funded research in New South Wales found that for every dollar invested in herbicides during the summer fallow period, the return on investment ranged from $3 per hectare to $8/ha.

This return on investment comes from more nitrogen in the soil in wet years and an increase of up to 86 millimetres more plant-available water at sowing when summer weeds are controlled.

However, the list of weeds for growers to control over summer is expanding and improved tactics need to be adopted to control these weeds while also avoiding glyphosate resistance.

A fleabane rosette at 5 centimetres diameter. Once larger than this, fleabane becomes difficult to control.

PHOTO: Michael Widderick

Fleabane

Dr Gill says fleabane has been one of the most problematic broadleaf summer weeds in the southern region over the past 10 years.

According to the GRDC's Impact of weeds on Australian grain production study, fleabane is the third-ranked summer fallow weed nationally by area, yield loss and revenue loss.

The University of Adelaide's Dr Gurjeet Gill.

PHOTO: Sharon Watt, Porter Novelli

The University of Adelaide team, led by Dr Gill and Dr Christopher Preston, has noticed fleabane plants starting to germinate in trial plots during late winter and early spring.

"Fleabane can be found throughout the southern region, usually on roadsides, but given the opportunity with rainfall in spring, it can start to establish in paddocks because of wind dispersal," Dr Gill says. "Fleabane plants at pinhead stage are there waiting for the right conditions and warming of temperatures. They will then start to grow and often only become large getting close to harvest.

"Once a crop has taken off and the canopy opens up, fleabane will start to grow quite quickly, which is when growers notice it."

Dr Gill says trials in South Australia, Western Australia and NSW have found a double-knock approach to be the most effective way to kill fleabane. This involves using glyphosate mixed with phenoxy herbicides as the first spray, followed by a second spray of paraquat a week to 10 days later.

It is important that the first knock is as effective as possible to get high levels of control with the double-knock approach.

New kids on the block

The encroachment of feathertop Rhodes grass (FTR) and windmill grass into the southern region from northern cropping areas is of particular concern for Dr Gill.

As part of a GRDC-funded project, Dr Gill has been looking into the biology and management of these weeds.

“FTR is an interesting one because its base temperature for germination – about 4°C – is fairly low by summer weed standards,” he says. “That is much lower than ‘normal’ summer weeds, which germinate at about 10°C.

“FTR appears to be a weed that is likely to be able to germinate under August or September temperatures and get a foothold earlier in the season than something like windmill grass, which belongs to the same genus.

“The other worrying thing about FTR is that seeds can spread up to 30 metres from the original plant, which confirms grower observations as to how easily it can spread.”

Windmill grass does need warmer temperatures to germinate, however Dr Gill says it does not rely on seeds for establishment.

“It can behave like a perennial plant, producing new leaves and regenerating from the crown,” he says. “Shorter periods of wet soil over summer may not be conducive for its seeds to germinate but because windmill grass can grow from the crown it can establish from that.”

Dr Gill’s research into FTR has found that a single panicle or head can have up to 1000 seeds, making it is easy to see how it has managed to spread so far. Furthermore, both FTR and windmill grass are hard to kill with glyphosate and therefore a double-knock is also the best approach to controlling these weeds.

“These weeds – both FTR and windmill grass – are inherently tolerant to glyphosate,” Dr Gill says. “What makes it worse is that we have identified two populations of FTR in SA which are glyphosate resistant.

“Again, we need to be using a double-knock. Farmers may be using glyphosate but they need to add a Group A herbicide to it as a first knock and then follow up with paraquat a week or 10 days later. Glyphosate alone will not solve the problem.”

Established foes

Another summer weed for growers to look out for across the southern region is heliotrope, or potato weed – the number-one-ranked summer weed in the southern region by area, yield loss and revenue loss.

Heliotrope (blue weed) behaves similarly to fleabane but can be killed with straight glyphosate in normal situations, Dr Gill says.

Sowthistle, traditionally regarded as a winter weed, has been found to be germinating later in the season and causing problems for growers through summer. The same goes for other weeds such as prickly lettuce and marshmallow weed.

“Their management, much like fleabane, works best with a double-knock strategy,” Dr Gill says.

“This year summer weeds could do particularly well. They are inherently hard to kill with glyphosate because of their genetic make-up but also because hotter, drier conditions are not conducive for glyphosate to work. This is why growers need to be looking at double-knock strategies.

“We often see broadleaf weeds such as sowthistle and prickly lettuce coming out of paddocks that have weak competitors such as lentils, field peas or pastures, allowing these weeds to continue into spring and summer and become a bigger problem.

“Cereals, on the other hand, tend to be more competitive against these weeds,” he says.

More information:

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Protecting knock-down herbicide options

Source: Cindy Benjamin—Weedsmart Bulletin Board: December 3, 2016

Most cropping systems rely fairly heavily on a small group of non-selective or 'knockdown' herbicides. Since the widespread adoption of zero and minimum tillage, these herbicides have provided effective control of many grass and broadleaf weeds – but these useful herbicides could be lost to the industry if steps are not taken to increase the diversity of weed management tactics used.

Mark Congreve, ICAN senior consultant, says that the highly effective double knock tactic, which combines an application of glyphosate followed by paraquat, is at risk if growers don't remain vigilant and ensure removal of any surviving plants.

The recent discovery of flaxleaf fleabane resistance to paraquat is a clear warning to grain producers that there is no room for complacency with double knock operations.

"The double knock strategy of glyphosate, plus a Group I herbicide for weeds such as flaxleaf fleabane, followed by paraquat has provided excellent control of weeds that are difficult to kill with glyphosate alone," he says. "Recent confirmation of a fleabane population that is resistant to paraquat, found in a New South Wales vineyard, is a clear warning to grain producers that there is no room for complacency following a double knock operation. In addition to this recent discovery, an annual ryegrass population from a West Australian vineyard was confirmed in 2013 to have resistance to both glyphosate and paraquat. This shows that a single plant can develop resistance to both of the main non-selective knockdown herbicides used in Australian grain production."

Paraquat is a widely-used herbicide, being an active ingredient in over 100 herbicide products registered for use in broadacre cropping. It is a group L herbicide and as such is considered a 'moderate risk' for herbicide resistance. Having a moderate risk rating means that resistance generally takes longer to occur, not that it won't occur.

"Paraquat resistance typically takes over 15 years of consistent use before resistant weeds are noticeable in the field," he says. "This critical period has now elapsed on many farms where paraquat is used in cereals and broadleaf crops, and for general weed control around the farm."

Mark Congreve, ICAN senior consultant says growers need to be looking for survivor weeds after every herbicide application and responding to 'rate creep' by changing how they use herbicides across their cropping system.

Paraquat resistance has been present and widespread in barley grass in lucerne production systems for many years in southern NSW and Victoria. While paraquat resistance is still relatively rare outside of lucerne systems, very high level resistance to paraquat was confirmed in three weed species (crowsfoot grass, blackberry nightshade and cudweed) taken from sugarcane and tomato blocks around Bundaberg in 2015.

In the event of widespread resistance to paraquat, Mark is concerned that there are no new modes of action likely to be commercialised within the next 10 years or more, so we need to protect what we have.

"It is essential that farmers do everything in their power to preserve the effectiveness of the herbicide groups currently available," he said. "The key is to take a diverse approach to weed management and, most importantly, remove weeds that survive herbicide applications. This is the best way to keep weed numbers low and when numbers are low, resistant weeds can be controlled more effectively. It's a numbers game!"

Mark suggests that growers check the results of every spray application, looking for individual plants 'surviving' or 're-growing' after a spray application that has killed adjacent weeds. This may be a sign that the

surviving plants carry the genetic mutation that 'protects' them from the herbicide's mode of action.

"If this is observed, the first step is to remove those individual plants before they shed seed," he said. "It is recommended to have the plants, or their seed, tested to confirm resistance and determine what herbicides those individuals are still susceptible to."

A second warning sign is when a higher rate of a herbicide is needed to have the same effect as achieved on the target weed in previous years. Mark called this 'rate, or dose, creep' and said that it is the most common sign of resistance to herbicides like paraquat. "Paraquat resistance primarily occurs as a result of a plant having the ability to re-direct the herbicide molecules away from the chloroplasts in the cell and into the cell vacuole, where the herbicide has no effect," he said. "If you are finding that you now need to use a higher rate of a herbicide such as paraquat, it is time to change how you manage those weeds."

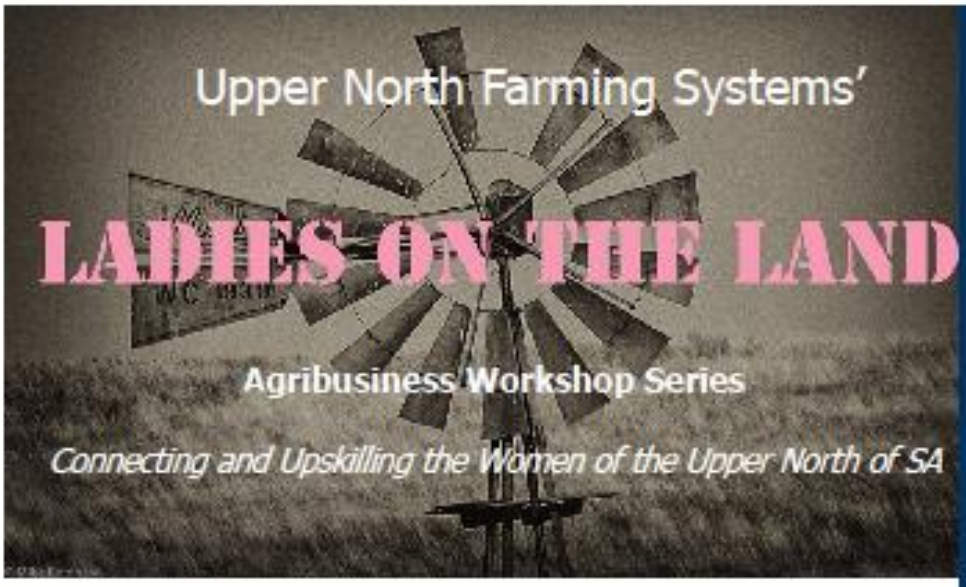
Non-crop areas around farms are often treated with paraquat annually. This can be a high risk practice unless survivors are removed after every spray application as there is no crop competition to restrict weed growth, resulting in production of large volumes of seed.

Herbicide resistance frequently occurs first along fencelines, roadways and irrigation channels where herbicide use tends to be the same year in year out and less attention is paid to survivor weeds or poor herbicide efficacy.

Currently there are 10 weed species with confirmed resistance to paraquat (Group L) and 13 species resistant to glyphosate (Group M) in Australia.

Species	Common name	Year confirmed	State	Crop
Hordeum glaucum	Northern barley grass	1983	Victoria	Lucerne
Arctotheca	Capeweed	1984	Victoria	Lucerne
Hordeum leporinum	Barley grass	1988	Victoria	Lucerne
Vulpia bromoides	Silver grass	1990	Victoria	Lucerne
Mitracarpus hirtus	Small square weed	2007	Queensland	Mangoes
Lolium rigidum	Annual ryegrass	2010	South Australia	Pasture seed
Gamochaeta	Cudweed	2015	Queensland	Tomatoes, sugar cane
Solanum nigrum	Blackberry	2015	Queensland	Tomatoes, sugar cane
Eleusine indica	Crowsfoot grass	2015	Queensland	Tomatoes, sugar cane
Conyza bonariensis	Flaxleaf fleabane	2016	NSW	Grape vines

Table 1: Confirmed paraquat resistance in Australia (Source: Australian Glyphosate Sustainability Working Group Paraquat resistance factsheet)



BECOME AN EFFECTIVE COMMUNICATOR

INTERACTIVE SESSION

CRECHE AVAILABLE - PLEASE BOOK

FREE WORKSHOP

Tuesday 31st of January

Booleroo Centre Community Centre

9:00am—2:00pm

"Communication—the ultimate Risk Management Tool in our business!"

Co-author of "A guide to communication for Farm Families", **Judy Wilkinson** will present an interactive session on Communication.

During the session participants will explore themselves and how this impacts on their interactions with others.

Activities and communication theory covered will assist participants to understand what it is that sometimes works and other times goes badly.

Thoughout the session participants will get the opportunity to discuss, practice and discover new ways of communicating.

Catering: Lunch supplied—please bring a plate to share for morning tea

For further details and RSVP – Jess Koch 0419 982 125
or
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SAGIT

Australian Government

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Handy GRDC Apps

Source: GRDC

The GRDC is interested in ensuring that farming can be made easier through a range of mobile based applications.

The free GRDC mobile apps now allow you to undertake activities in the paddock and interact with your networks on your iPhone or iPad. GRDC applications and further instructions are available on the GRDC website www.grdc.com.au/apps.

GRDC Storedgrain App

Storedgrain the application is designed to assist growers manage on-farm grain storage.

A key feature is the ability to record grain storage details and monitoring records at the storage site regardless of mobile reception or data speed.

Simply enter records you wish to keep and next time you're back in mobile reception range, records can be synchronized between multiple mobile devices and/or exported to Excel.

Record storage details such as grain type, variety, grade , quantity, paddock/ source, date filled, date emptied and who it was sold to for your own records and quality assurance tracking. Each time a storage is monitored the app allows you to record the date, temperature, moisture content, pests identified, treatment details and any other notes.

SoilWater App

SoilWater App (SWApp) provides Australian farmers and advisers with a ready estimate of plant available water in the soil (PAW) during a fallow and early crop phase. Soil water (PAW) can be a critical component of a crops water supply, influencing crop yield and profit.

Estimates of PAW contribute to richer decisions at planting and early in crop growth where inputs can be adjusted.

SWApp estimates soil water (PAW) using a tested water balance model and inputs from:

- weather data from a nearby Bureau of Meteorology (BoM) sourced from the Silo (www.longpaddock.qld.gov.au/silo); plus
- rainfall data from a local rain gauge (entered manually); or
- rainfall data automatically uploaded from a Bluetooth enabled rain gauge (10m range); and
- a soil description best suited to local conditions; and
- soil and crop cover conditions for each paddock.

The model in SWApp simulates infiltration, runoff, evaporation, transpiration and deep drainage to provide an estimate of soil water on a daily basis. Additionally, SWApp uses long term climate data to provide a forward looking estimate of likely outcomes for the specified soil, climate and cover conditions. Starting conditions are specified by the user and can be adjusted from sensors such as a soil push probe or soil water sensor network.

The functionality of SWApp will increase as more data sources come on-line (e.g. other climate and soil water networks and new sensors).

Acknowledgements
SoilWaterApp was developed for the Grains Research and Development Corporation project "New tools to measure and monitor soil water" (USQ00014) by the University of Southern Queensland. This App's development benefited from the significant contributions of grain growers and research scientists across Australia who contributed data for model testing and feedback on the user experience.

Nozzle outputs respond to nozzle design and tank mix

Author: *J. Connor Ferguson*

The tank mix can impact on spray quality and nozzle uniformity in unexpected ways, with the response often varying according to the design of the nozzle selected. GRDC-funded research at the University of Queensland (UQ) has highlighted how different types of 015 and 02 orifice nozzles can respond to changes in tank mix.

One area of research looked at how tank mix can affect droplet size and the uniformity of the spray output when different nozzle designs are used (Table 1). The studies showed that differences in nozzle outputs can occur when different tank mixes are used, particularly when compared with those published in the manufacturer's nozzle charts, which are normally based on spraying only water.

A TeeJet TTJ-60-110-02 nozzle used in the experiment. The spray quality moved from medium to fine at 3.5 bar pressure with the addition of the oil. However, there was also less variability between the TTJ60 110-02 nozzles tested when oil was added, compared with water alone.

PHOTO: J. Connor Ferguson

Many of the nozzles performed as expected by producing coarser droplets when a tank mix including pinoxaden and a methylated oil was used, compared with just water only. However, not all nozzle designs tested behaved this way. For example, the TeeJet TTJ60-110-02 operated at 3.5 bar pressure produced a finer spray droplet size with the same tank mix when compared with water only. (This result is most likely related to the specific design of this nozzle and should not be extrapolated to suggest all twin nozzles will behave this way.) One of the most uniform nozzles tested was the Hardi Minidrift Duo 110-02, which is also a twin nozzle.

Standard deviation in the range of $Dv_{0.5}$ (volume median diameter (VMD)) values (Table 2) was used to demonstrate the variability between nozzle types when different tank mix solutions are sprayed through them. Lower average standard deviation values indicate that the $Dv_{0.5}$ (VMD) remains more uniform when the tank mix is changed. This means the nozzle is more likely to produce a consistent output across a range of tank mixes. Larger average standard deviation values indicate larger changes in droplet size when the tank mix changes, which may require spray operators to carefully consider how and when to use such nozzles.

The UQ studies were conducted in highly controlled conditions in a wind tunnel using a laser diffraction particle-size measurement system that has shown an accuracy (or repeatability) within three per cent. The trials showed the drift-reduction capacity of many of the nozzles classified as very coarse and larger tended to be less affected by changes in the tank mix, whereas the droplet sizes produced by some of the nozzles that are classified by the manufacturer as medium spray qualities could become either coarser, or finer, depending on the tank mix. Spray operators need to take into account that changes in product or adjuvant rate, mixing parameters, application volume or operating pressure under field conditions may produce different results to those reported here.

The UQ research has highlighted the need for operators to be able to access specific information about the impact of the tank mix on various nozzle types, especially in relation to drift potential and efficacy impacts.

Table 1 Volume median diameter (VMD, or $Dv_{0.5}$) in micrometres (µm) and spray quality classification for a range of nozzles operated at 3.5 bar, using water and two herbicide tank mixes.

Nozzles tested (at 3.5 bar)	Water		Clopyralid		Pinoxaden +	
	Dv0.5	Spray	Dv0.5	Spray	Dv0.5	Spray
TeeJet XR 110-03 (reference)	218	F	223	F	248	M
Hypro Guardian Air 110-02	336	M	349	C	362	C
Lechler ID 120-02	572	XC	474	VC	436	C
TeeJet TTI 110-015	773	UC	650	XC	630	XC
TeeJet TTI 110-02	743	UC	667	UC	635	XC
TeeJet TTJ60 110-0	287	M	262	M	211	F

Dv0.5 or VMD is the droplet size (diameter in micrometres or µm) at which half of the spray volume produced by the nozzle will exist as droplets smaller than this size, and the other half will exist as dropets larger than this size.

SOURCE: University Of Queensland Centre For Pesticide Application And Safety

Table 2 Variation in the $Dv_{0.5}$ (VMD) produced by selected low-drift nozzles* operated at 3.0 bar, expressed as the standard deviation +/- from the $Dv_{0.5}$ (VMD) in micrometres (µm) for three spray solutions.

Nozzles tested (operated at 3.0 bar)	Water	Clopyralid	Pinoxaden + methylated oil	Average standard deviation
	Standard deviation + / – micrometres (µm)			
TeeJet XR 110-03 (reference)	7.33	4.69	4.45	5.49
Bellericay Bubblejet ABJ 110-015	28.62	26.01	14.52	23.05
Bellericay Bubblejet ABJ 110-02	9.60	5.11	3.54	6.08
TeeJet AITTJ60-110-02	8.40	8.72	9.78	8.97
TeeJet AIXR 110-015	5.44	10.28	9.06	8.26
TeeJet AIXR 110-02	19.63	16.40	12.80	16.28
Hypro Guardian Air 110-015	15.92	14.27	10.61	13.60
Hypro Guardian Air 110-02	6.14	8.17	8.73	7.68
Lechler IDK 120-02	4.64	6.35	4.84	5.28
Lechler IDKT 120-02	6.32	8.23	4.29	6.28
Hardi Minidrift MD-110-02	4.16	3.73	3.10	3.66
Hardi Minidrift Duo-110-02	5.23	2.30	3.53	3.68
TeeJet TTI 110-015	13.04	10.51	14.04	12.53
TeeJet TTI 110-02	5.39	8.71	12.25	8.78
Teejet TTJ60-110-02	41.71	11.69	5.83	19.74
Hypro ULD 120-015	7.75	14.11	8.54	10.13
Hypro ULD 120-02	7.63	3.39	3.89	4.97

*The range of nozzles listed in this table does not include all of the nozzles tested by J. Connor Ferguson.

$Dv_{0.5}$ or VMD is the droplet size (diameter in micrometres or µm) at which half of the spray volume produced by the nozzle will exist as droplets smaller than this size, and the other half will exist as dropets larger than this size.

SOURCE: University of Queensland Centre for Pesticide Application and Safety

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A Hardi Minidrift Duo 110-02 nozzle used in the experiment produced the least variation in the VMD when the tank mix was changed.

PHOTO: J. Connor Ferguson

Low dose phenoxy resistance

Source: [AHRI Insight #72, October 17, 2016]

Once upon a time we used to argue about whether smoking was bad for your health. We don't argue about that anymore.

In the world of weeds, we used to argue whether low herbicide rates cause herbicide resistance. We don't argue about this anymore. Both low rates and high rates of herbicide can cause herbicide resistance, but it seems that low rates are the fast track to herbicide resistance.

Dr Mike Ashworth inspecting a wild radish plant.

Dr Mike Ashworth from AHRI, evolved resistance to 2,4-D in wild radish. Mike started with only a few hundred plants of a known herbicide susceptible wild radish population, and in just four generations of recurrent selection with low doses, quickly evolved 8.6 fold resistance to 2,4-D.

And something unexpected happened as well, along with 2,4-D resistance, this wild radish also became cross resistant to the group B (ALS) herbicides Eclipse (metosulam) and Glean (chlorsulfuron)], even though these weeds had never been previously exposed to these herbicides.

This research potentially has major implications for farmers in the USA where new herbicide tolerant crop traits rely on the phenoxy herbicides. So keep the rates up!

There is a simple reason for low herbicide rates being the fast track to herbicide resistance. The genes that allow a weed to survive a low herbicide dose are as common as mud.

In Mike's research, he started with only 382 totally susceptible wild radish plants. You only need to start opening the drum of herbicide near these plants and they start to die! He grew them to the two-leaf stage and then sprayed them with 200mL/ha of 2,4-D Amine 625 (Amicide 625), which is about ¼ of the recommended rate, and 29% of them survived.

He then took 20 of these survivors, let them cross pollinate with one another and set seed. He then used this seed to grow 396 wild radish plants for the next selection. This time he sprayed the plants with 400mL/ha of Amicide 625. This process is what is known as recurrent selection. Mike did this for four generations as per the table below, treating three generations at low rates and the fourth generation at a high rate.

Almost one in three plants had the genes necessary to survive a low rate of herbicide in the first selection.

Table 1: Recurrent selection with 2,4-D Amine 625 starting with susceptible wild radish.

Generation	Rate of Amicide 625 applied	Population size	Herbicide efficacy (% control)	Survivors selected for seed production
Selected 1	200mL/ha	382	71	20
Selected 2	400mL/ha	396	88	20
Selected 3	400mL/ha	393	77	20
Selected 4	1200mL/ha	379	76	20

Perhaps one in 10 million plants naturally contain the genes to survive a full rate of 2,4-D. This is why low rates of herbicide are a bad idea.

Dose response curve shift

The dose response of the initial, un-selected population is the line made up of the solid circles. To kill 50% of the two-leaf wild radish (LD_{50}) in this population took only 25 mL/ha of 2,4-D. After four selections with 2,4-D it took 220 mL/ha to control 50% of the plants (o). This represents an 8.6 fold shift in resistance to 2,4-D.

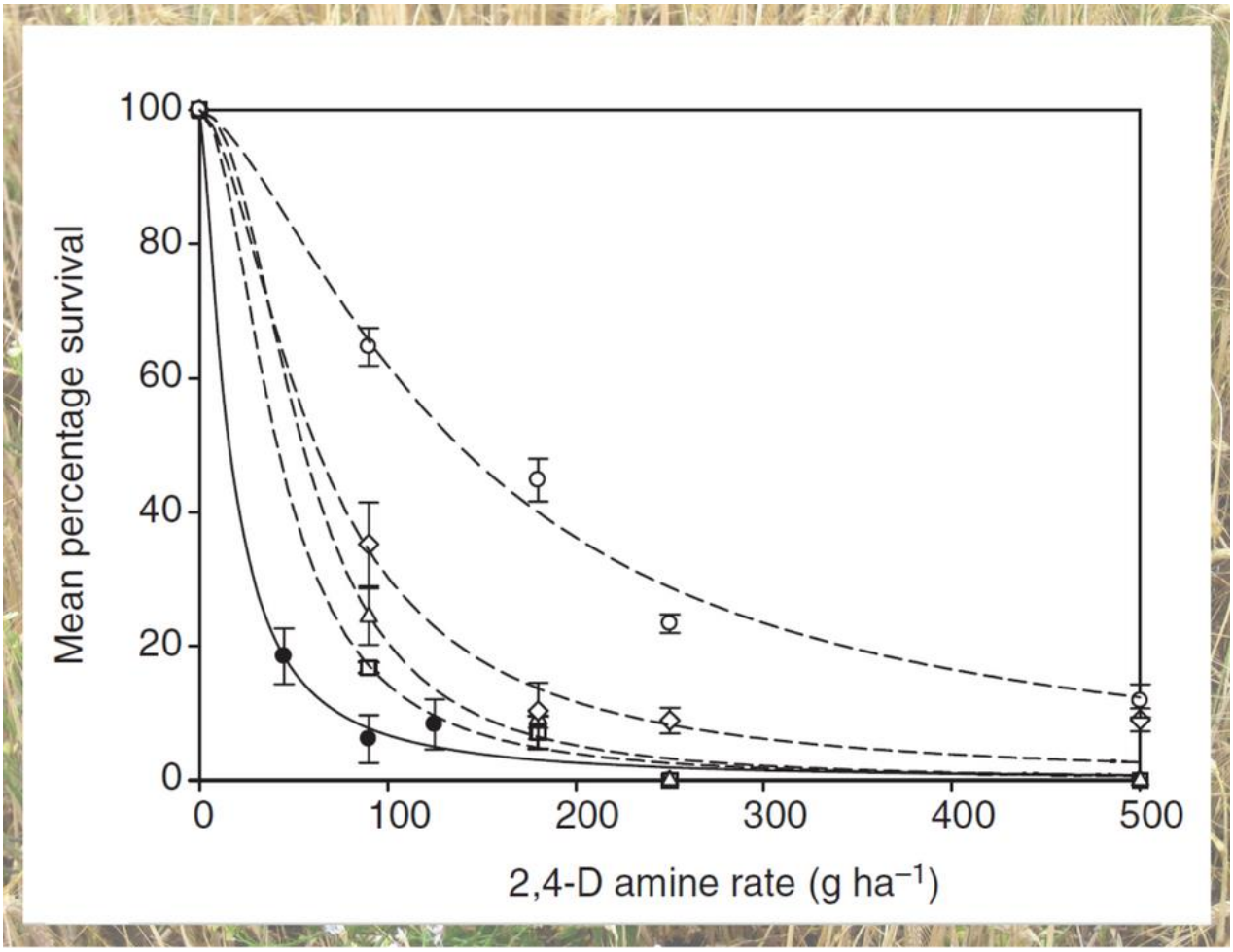

Figure 1: Dose response curves of wild radish recurrently selected with 2,4-D Amine. Commencing wild radish population (●), selection 1 (□), 2 (Δ), 3 (◊), & 4 (o).

Unexpected cross resistance to group B (ALS) herbicides

2,4-D and ALS herbicides are nothing alike, and there is no similarity in the mechanisms weeds use to evolve resistance to these herbicides. Yet somehow, recurrent selection with low rates of 2,4-D caused 4-4.5-fold resistance to the ALS herbicides Glean (chlorsulfuron) and Eclipse (metosulam). This ALS resistance was found to be due to metabolism by P450 enzymes. This was established by 'switching off' this resistance by spraying a P450 inhibitor, malathion over the wild radish 30 minutes before spraying ALS herbicides, restoring the ALS herbicides to full efficacy.

The really confusing part of this research is that P450 enzymes have never been implicated in 2,4-D resistance in previous research. More research is required to fully un-pack this one.

Conclusion

A number of studies in the past have demonstrated how low rates of herbicide cause resistance to evolve in grass weed species. This is the first such study in a dicot species, and the results are remarkably similar. Phenoxy herbicides such as 2,4-D are important weed control tools in Australia and they are soon to be extremely important in the USA as more phenoxy tolerant crop species are soon to be adopted by US farmers to combat glyphosate resistant broadleaf weeds. This research should sound a warning to these growers. Keep the rates up!

Sources

The paper can be found here Recurrent selection with reduced 2,4-D amine doses results in the rapid evolution of 2,4-D herbicide resistance in wild radish (Raphanus raphanistrum L.)

Water quality for spraying operations

Source: GRDC: Spray Water Quality Fact Sheet

Key points

⇒ Poor water quality can adversely affect many products. Always consult product labels and the manufacturer's technical information about water quality requirements.

⇒ Water testing should be done on a regular basis when using bore water, water from streams and rivers, reticulated (piped) water sourced from ground water, and water stored in unlined dams or concrete tanks.

⇒ Water tests should analyse the following to be useful: pH, total hardness (including a measure of bi-carbonate levels) and total dissolved salts (TDS) or salinity (electrical conductivity).

Why test water quality?

The quality of the water used for spraying operations can be critical to ensuring the best spray results for many farm chemicals. Many products can be affected by poor water quality.

When considering if the water quality is suitable for a particular product, you need to have accurate information about what may be present in the water that could affect the products you intend using.

The starting point should always be an accurate water test from a reputable laboratory and a thorough check of the product label and technical information from the manufacturer.

What should tests measure?

Water tests for spraying operations should include:

- pH;
- total hardness;
- bicarbonate levels; and
- either total dissolved salts (TDS) or salinity (eC or electrical conductivity).

While pH levels and total hardness can be assessed in the field using water test strips or simple titrations (jar tests), other measurements will typically require laboratory analysis.

If using test strips it may be useful to compare laboratory results to test strip results by setting aside water collected for analysis to check the accuracy of the strips. The strips can then be used to assess if significant changes in water quality have occurred and when another laboratory test may be required.

Commonly available water test strips include those supplied by Hach Pty Ltd (ranging from simple pool test strips to more accurate individual test strips and titration kits) or individual pH and hardness test strips supplied by Rowe Scientific Pty Ltd. Typically, these will be able to measure hardness or pH at varying levels of precision depending on the type of strips purchased. It is worth researching which may best suit your situation after receiving results from a laboratory.

Collecting water samples for testing

Use a clean container of at least 500mL size. Rinse the bottle a minimum of four times with the sample water (emptying it away from the sample site). Collect the water (see Table 1). Fill the bottle to the top, leaving little or no air space, and seal tightly. Label the bottle accurately with where the sample was taken, the date and intended use. Wrap the sample in aluminium foil to prevent UV light from degrading the sample.

Water pH

pH is a measure of the hydrogen ion concentration (H+), which indicates how acidic or alkaline the water may be on a 1 to 14 scale, where seven is considered neutral. Values below seven are acidic, values above seven are alkaline. Alkaline water (pH values typically above eight) can cause several problems. These include alkaline hydrolysis and increased dissociation (breakdown of the product), poor droplet contact with the target and reduced performance or stability from some formulations and adjuvants.

Water quality test strips can be used to assess pH and water hardness in the field.
Source: Hach.com

If considering reducing the pH of water to be used for spraying, a buffering agent or buffering surfactant will generally be simpler to use than straight acid. A buffering agent will reduce pH to a set point and hold it there, whereas straight acids tend to continue to reduce pH as you add more. Commercial adjuvants such as Li700 can reduce pH and have buffering capacity.

Acidic water (pH values typically below 4 to 5) can affect tank mix stability and lead to gelling of some salt-based products such as 2,4-D amines, particularly in tank mixes with some other salt-based and flowable products.

Water hardness

Total hardness is a measure of the amount of cations (positive ions) such as calcium, magnesium, sodium, iron and bicarbonates in the water, usually expressed in parts per million (ppm) or mg/L as calcium carbonate equivalents (e.g. CaCO3 mg/L).

Cations such as calcium and magnesium in the water

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can bind with negatively charged products such as the weak acid herbicides (e.g. glyphosate), so that they lose their activity in the target plant. Typically, water hardness above 250 to 350ppm (CaCO3 equivalents) should be treated before using several herbicides, particularly where pH is above seven. See Table 2 for examples of products affected by water quality.

Bicarbonates can also affect some products. Bicarbonate levels as low as 175ppm (mg/L) have been reported to reduce the efficacy of some group A herbicides and 2,4-D amine. Often it is useful to have the level of bicarbonates identified as a separate measurement in a water quality test.

Ammonium sulfate (AMS) can assist with water hardness. Ammonium sulfate-based products (such as Liase® and Liquid Boost) that are registered as adjuvants may be used with a number of products to reduce the impact of water hardness.

Ammonium sulfate is most useful when supplied as a formulated liquid (typically around 417grams/L) or in a soluble crystalline form (typically around 980gram/kg). These are often preferred by growers for their ease of mixing than the granular form.

Ammonium sulfate can assist in dealing with cations that may be present in the water, but by itself will not significantly change the pH, which may also need to be addressed at the same time to minimise issues such as alkaline hydrolysis and stability.

The amount of ammonium sulfate required can be calculated if a suitable water test is available. As a guide to appropriate amounts of ammonium sulfate to add to hard water, see Table 3.

Salinity (dissolved salts)

Salinity is usually measured as the electrical conductivity (EC) of the water.

High levels of salinity (above 1000ppm sodium chloride or ECs above 500-1000 microsiemens/cm) can result in some chemicals precipitating out of the solution and others being inactivated. It can also make it difficult to adjust pH using buffers.

Often the only solution with highly saline water is not to use it for spraying, or to greatly dilute it with clean rain water when it is available.

Dirty water (suspended solids)

Dirty or turbid water can adversely affect products such as Spray.Seed® and glyphosate due to the clay colloids suspended in the water. As a general rule, if a 10 cent coin cannot be seen in the bottom of a bucket of water it is too dirty for use with products affected by dirty water (see Table 4).

Filtering water and settling it in a holding tank prior to use can help to reduce turbidity. If using a settling agent, such as alum, only very small quantities should be used in accordance with the manufacturer's guidelines. Often too much alum is added to dam water, which can result in high levels of aluminum in solution. This increases hardness and creates more problems for several products than the untreated dirty water may have.

Temperature

Increased water temperatures can accelerate the breakdown of some products when the water quality

Table 1 Sample timing and location

A new bore or well	*Sample after pumping for several hours*
An operating bore	*Sample after running the pump for 30 minutes, collect as close as possible to the head of the bore.*
A stream	*Sample main stream flow*
A dam or lake	*Sample away from the edge and near the suction inlet to the pump. Ensure water is well mixed and filtered, or sample various depths.*

Table 2 Herbicide tolerances to water qualities

Herbicide	Water quality				
	Muddy	Saline	Hard	Alkaline (> pH 8)	Acidic (< pH 5)
Affinity®	✓	✓	✓	X	NR
Ally®	✓	✓	✓	Marginal	X
Brodal®	✓	✓	X		
Dicamba	✓	✓	NR	NR	
Diuron	✓	Test	✓	✓	
Diuron + 2,4–D amine	✓	Test	X	NR	
Diuron + MCPA amine	✓	Test	X	NR	
Fusilade Forte	✓	✓	✓	NR	X
Glean®	✓	✓	✓	Marginal	X
Glyphosate	X	✓	X	✓	
Hoegrass®	✓	✓	✓	NR	✓
Logran®	✓	✓	✓	Marginal	X
Lontrel™	✓	✓	X	X	
Sertin®	✓	✓	✓	✓	✓
Simazine	✓	X	✓	NR	
Spray.Seed®	X	✓	✓	✓	✓
Targa®	✓	✓	✓	✓	✓
Tigre®	✓	X	X	NR	
Trifluralin	✓	✓	✓	✓	
Verdict®	✓	✓	✓	NR	✓
2,4–DB		X	NR		
2,4–D or MCPA amine	✓	✓	X	NR	
2,4–D or MCPA ester	✓	Test	Test	✓	✓

Key: ✓ = OK; X = Do not use; NR = Not recommended but use quickly if there is no alternative; Test = Mix herbicides and water in proportion and observe any instability; Marginal = Not ideal, but acceptable

Source: Weed Control in Winter Crops, 2011 – NSW DPI

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is not suitable. Low-temperature water can lead to solubility problems and gelling in the tank (even in clean water).

Summary

Poor water quality can adversely affect many spray jobs, particularly where products remain in the tank for extended periods, where high water rates are used, or where low rates of product are used.

Know what your water quality is and how to treat it when using different products.

More inForMation

Bill Gordon Consulting 02 6647 7564, bill.gordon@bigpond.com

Table 3 Water hardness levels (WHL) and recommended treatment with AMS to alleviate the effects of hard water

Water hardness level Ca++ ppm	Water hardness level $CaCO_3$ ppm	Water hardness level	Syngenta Boost (AMS) recommend mL/100L
80	200	0.69	250
120	300	0.89	375
160	400	1.18	500
200	500	1.48	625
240	600	1.78	750
280	700	2.07	875
320	800	2.37	1000
360	900	2.66	1125
400	1000	2.96	1250
500	1250	3.70	1565
750	1875	5.55	2345
1000	2500	7.40	3125
Calcium	Calcium carbonate	1 WHL = 342 parts per million (ppm)*	

* testing kits are available in measurements of 342ppm or 1000ppm

Source: Syngenta Technotes Tn08-379 non-Selective Herbicides and Adjuvants

Table 4 Examples of products affected by water quality

Active/products	Hardness	Bicarbonates	Salinity	Muddiness	Alkalinity
Alpha Cypermethrin C (Fastac® Duo)					
Atrazine WG	Liase®				
Chlorsulfuron (Lusta®)	Liase®		Avoid		
Clethodim (Sequence®)		Liase®			
Clopyralid (Archer®)	Liase®				LI 700
Chlorpyrifos EC					LI 700
Cypermethrin EC					LI 700
Dicamba Amine (Kamba® M)	Liase®				LI 700
Diclofop-methyl (Nugrass®)					
Diflufenican (Agility®)					LI 700
Diflufenican/MCPA (Nugrex®)	Liase®				LI 700
Dimethoate					LI 700
Diquat/Paraquat (Revolver®)				Avoid	
Diuron	Liase®		Avoid		LI 700
Diuron + 2,4-D amine	Liase®	Avoid			LI 700
Diuron + MCPA amine(Agritone® 750)	Liase®		Avoid		LI 700
Glyphosate	Liase®			Avoid	LI 700
Roundup DST	Liase®			Avoid	LI 700
Glyphosate (Credit® + Bonus®)				Avoid	
Glyphosate (Roundup™ PowerMAX)	Liase®			Avoid	
Imazamox/Imazapyr (Intervix®)					
Imazamox (Raptor®)	Liase®				
MCPA amine	Liase®				LI 700
MCPA ester	Liase®		Avoid		
Phosmet (Imidan)	Liase®		Avoid		LI 700
Simazine 900 DF	Liase®		Avoid		
Tepraloxydim (Aramo®)		Liase®			
Tralkoxydim (Achieve®)		Liase®			
2,4–D ester (LV Estercide® Xtra)	Liase®		Avoid		
2,4–D amine (Surpass® 475)	Liase®	Avoid			LI 700

Chart legend: Managing water quality – recommendations depend on the severity of problem

Can be managed with Liase	Liase®	Generally no problem	
Can be managed with LI 700	LI 700	Water should be avoided	Avoid

Source: Nufarm nozzle Charts 2009 and Nufarm Spraywise Spray Log

Water Quality Testing - Frequently Asked Questions

Where can i get my water tested?

Check with your local department of agriculture or primary industries, or talk to your local chemical reseller about suitable laboratories in your state. Some chemical and adjuvant manufacturers also offer water testing through the reseller networks.

Where can i buy test strips?

Some of the basic test strips for pH and hardness are available in hardware stores or through stores that supply pool equipment. For more accurate test strips visit the manufacturer's websites to locate a local distributor (Hach.com or rowe.com.au)

How often should i test my water?

If using bore water or water sourced from the ground, obtain a full laboratory test annually and not more than two years apart. If extending the interval between tests to two years, use test strips to check water quality in between. If a significant change in pH or hardness is noticed on the test strips get the water retested by a laboratory.

What should I do before mixing a spray load if I am not sure about the water quality?

Conduct a jar test to ensure the tank mix will be stable. For susceptible products use a robust rate of product and utilise an acidifying buffer/adjuvant and ammonium sulfate where appropriate.

Upcoming Events Calendar

January	
31	Ladies on the Land - Communication Workshop - Booleroo Centre - Jess Koch 0419982125
February	
7-8	GRDC Farmer Advisor Update, Adelaide,ORM Communications 03 5441 6176
9	GRDC Grains Research Update, Loxton, ORM Communications 03 5441 6176
17	Soil Water Workshop for Researchers & Advisors, Pt Lincoln, Naomi Scholz 0428 540 670
17	BCG Trials Review Day, Birchip. BCG 03 5492 2596
20 – 24	Grain Biz – Unwrapping your Business Grain Marketing Potential, Clare, Rural Directions 08 8841 4500
22-23	UNFS Grassy Weeds and their Management Workshops - Nelshaby and Orroroo
28	Work Health & Safety Roadshow, - Cummins & Minnipa, GPSA, 1300 734 884
March	
1	Work Health & Safety Roadshow, - Kimba, GPSA, 1300 734 884
2	Work Health & Safety Roadshow, - Clare & Maitland, GPSA, 1300 734 884
22	Work Health & Safety Roadshow—Lameroo, GPSA, 1300 734 884
23	Work Health & Safety Roadshow—Keith & Naracoorte, GPSA, 1300 734 884
April	
6 – 7	Ag Excellence Annual Forum & Awards, Adelaide, Kerry Stockman 0418 841 331
July	
18	Hart Field Site Winter Walk, Sandy Kimber 0427 423 154
September	
19	Hart Field Day, Sandy Kimber 0427 423 154
26-28	Yorke Peninsula Field Days, Paskeville Elaine Bussenschutt 08 88272 040
October	
17	Hart Spring Twilight Walk, **Sandy Kimber 0427 423 154**

Bite Size funding now available

Following the success of Natural Resources Northern and Yorke's Bite Size Grants program in 2015/16, a second round of the funding initiative is now open. The program is designed to help kick-start environmental projects with a natural resource management outcome.

Natural Resources Northern and Yorke Performance and Reporting Coordinator John Peet said the grants will help community groups and schools achieve small and short term projects. "Bite Size Grants of up to $500 can help community and volunteer groups and schools to achieve outcomes that benefit the environment," Mr Peet said.

"With more than 25 successful applications in 2015/16, the completed projects showcase the diversity of natural resource management in the Northern and Yorke region." Previous projects include:

- tree planting at the Booleroo Centre playground and bike track
- native plant revegetation and development of a native habitat garden at Georgetown Primary School
- production of weatherproof labels for the Corny Point Community Indigenous Nursery
- establishment of a native vegetation garden around Hawker's ANZAC Memorial
- assisting with funding for external speakers for an Environmental Education Day at Peterborough Primary School
- purchase of colour-coded bins to promote recycling at the Clare Valley Childrens Centre
- covering some of the start-up costs to support the formation of the Quorn Landcare Group

"We would encourage local community and volunteer groups and schools to consider if they have any projects to help their environment and promote a better understanding of natural resource management in this region," Mr Peet said. The Bite Size Grants will be rolled out throughout the year, with applications assessed regularly. Groups that are unsuccessful in one funding round can apply in future rounds, with only one Bite Size Grant available to any group for the year.

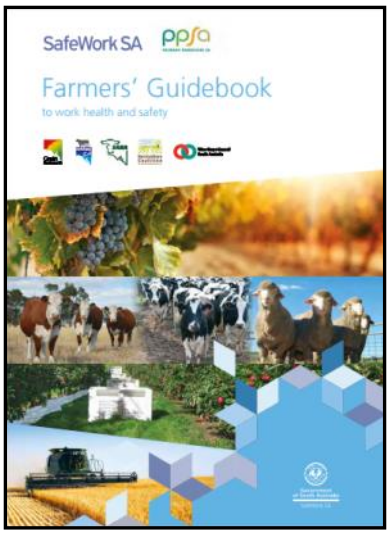
Application forms are available **here**. For more information or assistance with applications contact the Northern and Yorke Natural Resources Centre in Clare on 8841 3400.

Government of South Australia
Natural Resources Northern and Yorke

Work Health and Safety Roadshow

Primary Producers SA, Grain Producers SA and SafeWorkSA will be conducting the Work Health and Safety Roadshow in early 2017.

It involves a series of regional workshops designed to present the themes of the new WHS Guidebook for Farmers, launched in September, directly to farmers.



The workshops will cover requirements of farmers in terms of WHS policies, duties and obligations, employing or contracting staff, safe work practices, hazard identification in the workplace and risk assessment. Each workshop is aimed at creating a local WHS network for ongoing community support.

Dates and locations in early 2017 include:

February 28 – Cummins and Minnipa
March 1 – Kimba
March 2 – Clare and Maitland
March 22 – Lameroo
March 23 – Keith and Naracoorte
More locations will be promoted in soon.

Details: Stay tuned for more information to be postedunder events on GPSA's website.

ppsa PRIMARY PRODUCERS SA
Grain Producers SA
Government of South Australia
SafeWork SA

Wet conditions bring new problems for livestock producers

Source: Patrick Kluver, Manager Biosecuriy & Extension—Livestock Biosecurity Network

Farmers have welcomed wetter than normal conditions after some ordinary rainfall in recent years, but apart from devastating floods, animal health problems can also be an issue.

The most recent wet spring summer was 2010 /11 and we can look back at some of the lessons learned during that season.

Lame sheep and cattle

We have seen a lot more lameness in sheep this year, mainly due to wet and boggy conditions causing an increase in foot abscess, especially in heavier types of sheep. Footrot is also being seen in areas where it hasn't occurred for a number of years. If sheep are lame, it is a good idea to confirm what is wrong with them. Lame sheep are not productive and ongoing feet problems can usually be managed, or in the case of virulent footrot, eradicated. This is not the season to ignore that nagging intermediate strain of footrot so get it diagnosed and get rid of it.

Lumpy wool and fleece rot

In sheep, we are already seeing an increase in **lumpy wool** and **fleece rot**. Lumpy wool or 'dermo' starts as an infection on the skin and the subsequent ooze causes the wool to matt together in lumps. Young sheep are susceptible due to their open fleece. Lumpy wool can make shearing impossible. The disease can be self-limiting but if a large number of weaners are affected, and shearing is coming up, consider antibiotics to control the infection and allow the lumps to grow out from the skin level with natural wool growth.

Fleece rot is seen with prolonged wetting of the fleece down to the skin, and leads to downgrading of wool and increased susceptibility to body strike. If sheep have a noticeable level of fleece rot then consider some fly strike prevention and see it as an opportunity to get rid of it, as susceptibility to fleece rot is a highly heritable characteristic.

Parasites

In general, most of the parasites we deal with are worse in warm wet conditions. Both fleece rot and lumpy wool make sheep susceptible to **fly strike**. Remember with blow flies, you breed your own, so if you use preventive treatment before fly numbers build up it will save a lot of heartache later in the year. You may wish to treat early if you are likely to be busy with other things like harvest or there is a fly product shortage around Christmas.

Mosquitoes and midges can also be a problem spreading unpleasant viral infections like **Three Day Sickness** and **Akabane**. In very wet years, Three Day extends as far as Victoria, out of its normal range in northern New South Wales and Queensland.

Intestinal worms love this type of weather, and once temperatures start to increase, **barber's pole** worm will become an issue in many areas. Monitor worm egg counts and look out for sheep with clinical signs of worm burdens.

Liver fluke will be a problem on farm, especially in areas that have experienced two wet summers as the fluke that built up last year will have multiplied.

Excess feed

Excess feed is always better than not enough but be cautious with weaner sheep welfare and what appears to be ample feed on offer. Young sheep don't usually do well on long standing grass, especially if it starts to go rank. Regular monitoring is the key to make sure they are maintaining or slowly gaining weight over summer.

With cattle, **bloat** can be an issue with clover dominant pastures. Clover and other legumes can cause frothy bloat and cattle are most susceptible in the morning or when they are first introduced to a pasture. If you see cattle with mild bloat, gentle movement off the paddock on to hay with or without some bloat oil. A severely bloated cow is an emergency requiring surgical intervention so call your vet straight away. Bloat can be prevented with spraying, capsules or avoiding dangerous pastures.

Also look out for…

We have already seen cases of **Theileriosis** in naïve cattle from tick free areas to areas with endemic Theileriosis. Western cattle that have moved into coastal areas are particularly vulnerable so be sure to look for sickness and weakness in newly introduced cattle.

If you are in marginal country keep an eye on **trace elements** like copper cobalt and selenium. Wet seasons can exacerbate trace element deficiencies and push marginal areas into deficiency.

LBN

Upper North Farming Systems

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