Producer's perspective: the swing to forages

D Maxwell and T Maxwell

"Mountain View" and "Glenarden", Wee Waa, NSW 2388: david@candw.com.au

Abstract: *David and Tracy run a 1597 ha sheep and dryland cropping business, split into two blocks, north and north west of Wee Waa in northern NSW. The soils are dominated by deep black cracking clays with intermittent red soil ridges. Over the past five years, excluding the current drought, they have run up to 1300 Dorper ewes across the two blocks. They have the capacity to farm 705 ha, of which 317 ha is developed for flood irrigation. The forage base includes 105 ha of old man saltbush, 202 ha of tropical perennial grass, and 690 ha of native pasture country. A nagging 'gut feeling' inspired David to closely analyse their trading figures, which suggested the farming enterprise was not as profitable as they thought. Now, with an expanding forage base of tropical grasses, the Maxwell's are seeing some handy returns from their Dorper enterprise. However, along the way, they have learnt some painful and valuable lessons about grazing management. Does it mean they will stop cropping? The short answer is no, but it comes down to particular circumstances, scale, land types, capital position, labour capacity and climate variability.*

Key words: tropical grass, cropping, Dorper, old man saltbush

Introduction

My wife Tracy and I run a sheep and dryland cropping farm on 1597 ha split into two blocks, "Mountain View" 829 ha 12.5 km directly north of Wee Waa and "Glenarden" 766 ha 60 km north-west of Wee Waa. In addition to this, we have three kids and I work as a full-time partner of a 50+ staff accounting firm. Needless to say, I am quite time poor so our farm has to be labour efficient and cash positive. Capital gain is nice but we have two elderly parents to support so the business has to generate positive cashflow.

Farm description

Soils and landscape

On "Mountain View" the soil types are a 75/25 mix of deep black cracking clays with intermittent red ridges. Most paddocks will have a mix of both soil types. On "Glenarden" the mix would be closer to 50/50 with some heavy belts of belah timber.

Climate

The long-term average annual rainfall is approximately 525 to 550 mm, which is neither winter nor summer dominant. However, the value would be significantly less than that if we took an average of the recent 10 years. Basically, the rain stopped in about November 2016 and we haven't had a single day rainfall total greater than 45 mm since. In 2017 we received 370 mm and in 2018 we received just 289 mm, but since November 2018 we have received 56.5 mm.

We seem to be receiving rain in clusters of events over a few weeks and then it disappears for periods ranging anywhere between 2–4 months. We primarily rely on cap & pipe water at "Glenarden" and bore water at "Mountain View"; any dams that we have ran dry several months ago.

Livestock

When we purchased our first part of "Mountain View" from my parents we ran a Merino x Border Leicester first-cross operation. We started trading steers, but found that their performance on the saltbush was poor. In approximately 2006 we started running Dorper sheep. The shift to Dorpers was driven largely on their ability to handle tougher conditions. Being a full-shedding breed and given my full-time workload, I did not have to worry about flies, lice, shearing and crutching, which were all important considerations. The Local Land Service (LLS) recommended stocking rate is approximately 2.5 DSE/ha. We have tried as best we can to only keep the stock on our grazing land, but in dry times we will let them graze stubble on the cropping land. Ignoring the current drought, in the last five years, our business mix has 1300 Dorper ewes spread relatively evenly between the two blocks.

Drought strategies

Until recently we had 415 t of grain storage capacity; a 200 t grain shed and 215 t silo. In March 2019, we added further capacity with a 344 t silo. The aim is to fill them the next time we get a crop and keep them full. We also make our own hay, which we keep in our two haysheds and under hay caps. We use wheaten hay for weaning and barley stubble in the feedlot.

The planting of deep-rooted perennials such as old man saltbush, Bambatsi panic, Gatton panic, Premier digit and Bisset creeping bluegrass is also a significant part of our drought management strategy. We have also divided our paddocks into several small paddocks, which we are able to lock up, confine our stock to just a few sacrifice paddocks and destock until it rains. The idea is that when it does rain we have sufficient ground cover on our saved paddocks to respond more quickly to the rain event.

We have a five-cell feedlot to ensure that we can always sell a finished lamb. These cells can be turned into a drought lot for our ewes if necessary.

Due to my working off-farm, we don't have access to any form of drought assistance. Therefore, we have to always be prepared for drought and we try to make ourselves as drought proof as possible. There is more we would do but that all takes capital. With low-interest loans, there is much more we could do and we would be a lot further down the track by now.

Pastures and/or forages for livestock

To fill our feed gaps in the past we have tried to grow fodder crops ranging from dual-purpose wheat, forage barley, to millet and pastures like vetch and lucerne, but with very mixed success. There were some good wins but more often than not and the nett result was a short grazing window. Typically, there would be a dry spell followed by a good rainfall event that resulted in going from no feed to so much feed we couldn't stock it heavily enough. In turn, it would run to seed, which meant we had to quickly de-stock. Added to this, the seed was relatively expensive and with a long fallow lock-up period over summer, we were going back to a higher cost structure of cropping. We needed a crop that provided a sustained and reliable feed supply from a rain event, even if it came at the cost of surrendering maximum production.

In 2002 we planted 65 ha of old man saltbush at "Mountain View" and 40 ha at "Glenarden" in a configuration of twin rows 1 m apart and then a 5 m space then two more rows. We planned to sow perennial grasses between the rows after the saltbush was established (as advised) but there was a bit of a mix up at planting and the gap between the rows became quite variable anywhere between 3 to 5 m, which made it hard to get a planter in. We later tried spreading grass seed, but nothing really established. Subsequently, we ended up with a stand that was just too thick and we have never been able to get a perennial to establish between the rows. So we have adapted with the use of barley straw and some grain supplementation. Prior to planting saltbush, we were running approximately 1 ewe/ha, but the saltbush has significantly increased our stocking capacity and gives us the flexibility to rest or graze paddocks. In the past, we have been able to run 700 ewes and small lambs on the 65 ha of saltbush for at least 12 weeks with only the addition of some barley straw as a supplement.

Our native pastures were hit and miss; if we have a decent winter our country grows a lot of burr medic and wild turnip, annual phalaris and annual ryegrass which is good feed up until it goes rank. As for summer pasture, we were heavily relying on the annuals of barnyard and liverseed grass, yellow vine, windmill grass, couch grass, button grass and a lot of black roly poly.

Cropping

"Mountain View" is in the middle of the dryland cropping and irrigation district of Wee Waa, we currently crop 705 ha, of which 317 ha was developed for flood irrigation.

For the past 16 years, we have run a zero-till cropping operation growing wheat, barley, chickpeas and faba beans in rotation under the guidance of one of the districts leading agronomists. We contracted the planting and the harvesting, which resulted in a slightly higher cost structure. We weren't cutting corners.

The Review: Does one size rule fit all?

On a spreadsheet, nothing beats cropping from the viewpoint of enterprise profit margin. In my district, it is just accepted by the banks, the agronomists, accountants, benchmarkers and chemical companies that if you want to make money, the "universal truth" is, you must crop. Livestock are only an acceptable side-line if they do not interfere with the cropping.

I knew all this, for after all, it is a "universal truth", but for several years I had a "gut feeling" that the reality and the theory just weren't aligning. For the record, accountants have the worst books; it took me about five wet weekends in a row in 2016 to sit down and actually work through our past eight years of trading figures to confirm my "gut feeling" was in fact correct.

In eight years of cropping, we made just three profits; since then it had only gotten worse. Including 2019, our farming had delivered profits in four of 11 years. In theory, we were doing everything right, but our scale and a "hot week" here and a "dry spell" there has sapped our profitability. Together with the fact we were also farming some paddocks that contained a real mix of soil types, it was clear the 'spreadsheet' didn't allow for the variability and scale efficiencies.

The sheep operation, on the other hand, kept plugging along just nicely. The operation has a low-cost structure and a medium output, which has allowed us to see through the ups and downs and still turn a profit. Over the last six years, it has proven to be a reliable medium output operation. We have lambed every eight months with a weaning rate of around 112–120%. The 4-year average (2014–2017) price has been around $140 per lamb, and the average price through 2018 and 2019 is considerably better again. And there is still plenty of room for improvement.

Decision time: it was clear that something had to change

The numbers dictated that something had to change and the answer wasn't to double down on cropping! If we were going to expand our stock numbers, the next decision was how do we expand – fodder crop v. perennial crop?

As stated earlier our experience with fodder crops was not delivering a reliable feed supply around which we could organise our grazing system. Due to the recent growing seasons and our smaller scale, fodder crops were relatively expensive. We were achieving a reasonably short grazing window considering the time that was spent on preparing the paddock. To be fair I do think that Dorpers probably do better on the harder feed but generally, it wasn't so much about the quality of the feed. Rather, it was the length of the grazing window the fodder crop gave us and this was largely dictated by rain or lack of it.

The problem we were finding was that we got a big dump of rain and then nothing for a while. We believe that perennial grass allows us to better retain a greater proportion of the bigger rainfall events compared with fallow paddocks.

What to plant?

Old man saltbush is fantastic in measured doses. It has a three-tiered root system that can reach down to 5 m deep and up to 3 m across, which makes it a reliable drought-proof feed source. Its high protein, low carbohydrate and high salt levels make it great forage as part of a mixed diet, but it definitely needs a metabolisable energy source, such as perennial grass forage, with it.

Native perennial grasses were an option but just didn't produce enough biomass to make them a viable alternative. Tropical perennial grasses seemed to fit the bill. They appealed to us because they were considered a drought-proof plant that had good water use efficiency, which led to large palatable biomass and long growing season.

So in December 2016, we decided to plant tropical grasses in 130 ha of our least profitable farming paddocks, one common factor was that they all had red ridges in them. We did it all by the textbook (Harris et al. 2014). We chose a blend of Bambatsi and Gatton panic, Floren bluegrass, Premier digit and Bisset creeping bluegrass. With a large rain event on the way, we sowed 10 mm deep into stubble. However,

the rain event that was there only days before, disappeared for 3 months. But, we eventually got up 10 ha, all in the last corner planted. We figured out that the 10 ha came up when the press wheels were pushed down a little harder, and the deeper planting seemingly was the success with our heavy soils.

In December 2017, we re-planted the remaining 120 ha, but this time we planted 25 mm deep and the germination was excellent, with up to 12+ plants per m^2. We didn't realise it at the time, but approximately 90% of the grass was Bambatsi or Gatton panic. We didn't care as there was just so much feed we couldn't believe it.

In December 2017, we also planted a further 72 ha of the same mix as before. We again sowed 25 mm deep, and again achieved very good germination of Bambatsi and Gatton panic with <10% of Floren bluegrass, Premier digit and Bisset creeping bluegrass.

The sea of grass: how do we graze it?

Being time poor, managing lots of little paddocks and moving livestock every few days just wasn't an option. Initially, we lambed down a mob of 325 scanned in lamb ewes in a 66 ha paddock for about 10 weeks. During this time we had about three reasonable rainfall events. At lamb marking, we only marked 102% of lambs and took out 86 dry ewes. We were a bit disappointed and blamed the vendor of the ewes (my brother-in-law) for selling us rubbish!

At the same time, we had ewes and weaner size lambs in another 40 ha paddock. They stayed for about five weeks but only grazed a 100 m wide strip between the water trough and the trees. It wasn't until I was driving my father around the paddock, a week after 37 mm of rain, that we noticed about 10 lambs were dead along the strip between the trough and the tress. There were also several lambs huddled under shrubs and trees.

We had a problem and its name was saponin toxicity (Slattery 2019). The fresh shoots of the panic varieties are particularly toxic for the first two weeks after a rain event. Mature sheep seem to be able to handle the toxicity or avoid grazing the shoots, but anything under about 12 months of age seems to be very vulnerable. We lost approximately 30 to 40 lambs out of this event alone.

Saponins, which are particularly nasty toxins, affect the liver and the most obvious clinical sign is photosensitisation. Once they were affected, there was very little we could do with them other than locking them up in a dark place, feed them some grain and hay and hope for the best. All the experts advised us that this was a "one in twenty" event and to get it first time out was just plain unlucky.

In order to reduce the risk of more saponin poisoning, we decided to change our paddock sizes to no more than 20 ha each. We ran the whole flock together in one mob and moved them out of these paddocks immediately after rain. Our logic was that we would move the sheep into a paddock with larger and more mature plants, thereby reducing the percentage of fresh shoot for them to graze on. This plan worked well for the next 6–8 months as it didn't rain much.

In March 2018 we were hit again, this time we lost approximately 140 lambs and again we were told that this time we were "incredibly unlucky" as this was unheard of. Quite a few phone calls later and talking to other experts we found that by feeding lambs on panics within 2 weeks after the rain we were going to kill young sheep every time; 1 in 20 was really 1 in 1. In hindsight, we were actually hit three times with saponin poisoning; the first time we didn't know about it as we hadn't yet marked the lambs.

What have we learnt?

- We need a new grazing system. Our current plan is to remove all sheep from tropical pastures as soon as it rains. We put them on the saltbush for 3–4 weeks (to be safe) and then put them back and monitor them closely.
- We need to plant more improved pastures, but next time I think we will avoid the panics and reduce our sowing depth. If we manage to get these pastures up we will keep these for any stock under 12 months of age. The only problem with our new plan is that it just hasn't rained for about two years.
- When planting more saltbush stands, establish

the grasses first and plant the saltbush in twin rows approximately 20 m apart.

- When in doubt lock the lambs up in the feedlot pens until we can get the safe pastures established.

Do the numbers still stack up?

The short answer is yes. In a 20 ha paddock, we ran 800 ewes and 900 4–5-month-old lambs for five weeks and no saponin poisoning. We just need to be vigilant and have alternative grazing options available after rain events.

The LLS rate our area at 2.5 DSE/ha. Our aim is to run >2.5 ewes/ha (which we have already achieved), lambing every eight months with a minimum marking rate of 100%. At a sale price of $140/lamb (i.e. our 5-year average minimum price), taking out approximately 40% for costs (including fixed costs but not feedlot costs), our resulting net profit margin is approximately $311/ha. That matches a good wheat crop.

Unfortunately, since November 2018 at "Mountain View", we have had 56 mm of rain and our ewe numbers have dropped from 700 to 460 and we have 200 maiden ewes. In spite of the lack of rain we are still generating a reasonable cash profit. The fact that for the last two years our lambs have averaged in excess of $190/head just gives us a bit more room in our figures.

Should we put it all down to grass and stop cropping?

The short answer is no. In a good season, cropping in the Wee Waa district does work. Generally, it is the one enterprise that can deliver significant bursts of profit that can be used to retire debt. Interestingly we have found that our worst farming paddocks are in fact our best paddocks for grass, while our better farming paddocks have struggled.

No two farms are the same and what best suits your particular farming business depends on many factors such as your scale, land types (breakdown to individual paddocks), capital position, labour capacity and climate variability, so there is no "one size fits all". In our situation, it is clear that we need to take our cropping from our primary enterprise to our opportunity enterprise. The sheep need to become our primary enterprise as that suits our situation. However, it might not necessarily be the same for your mix of enterprises.

The future

At "Mountain View" we plan to establish a further 200 ha of tropical grasses. This will leave us with approximately 275 ha of cropping country, which we will try to keep in a simple rotation of faba beans and barley or dual-purpose wheat. After filling our silos and hay sheds, anything leftover can be sold.

At "Glenarden" we hope to start planting tropical grasses but we have a few hurdles to clear there first. If we can get everything developed as planned we aim to run approximately 2200 ewes, selling approximately 3300 lambs a year, but all this depends on rain.

Conclusions

What have we learnt? A lot of things. The first is don't fall victim to your hubris because a big paddock of grass isn't always your friend.

Know and manage your costs and your risks as best you can. Too many people try to manage their income and lose sight of the costs. Unfortunately, in agriculture, there are many factors that affect the income that we can't control. Always be on the lookout for ways to improve as it is much cheaper to learn from someone else's mistakes than from your own.

Acknowledgments

There are many people to thank for their inputs that have helped us on this journey, so for fear of missing someone, we simply say thank you all. Thank you to the Grassland Society of NSW for inviting us to share our story.

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Integration of on-farm silage systems for enhanced beef cattle production

JJ Catts

"Glen Ayr", Baradine, NSW 2396: catts@futurityshorthorns.com.au

Abstract: *With increasing climate variation, livestock producers are required to safeguard their enterprises to stay viable. On-farm silage systems that harvest fodder crops are becoming more relied upon as a management practice to manage seasonal variability, reduce overgrazing of pasture and decrease the age of turnoff, whilst increasing live weight gains of cattle. This paper is a producer's account of the benefits of developing an on-farm silage system, from growing the fodder though to feeding it to livestock and the enhancements to profitability and environment it brings.*

Key words: silage, profit, opportunity, sustainability

Introduction

Futurity Shorthorns is a beef seedstock and cattle trading business. The seedstock section supplies live animals and genetics throughout Australia and internationally. The cattle trading operation is an opportunity-based business that is flexible by design to allow variations in stocking rate.

The farming operations are in north-western NSW with "Glen Ayr" and adjoining holdings totalling 2550 ha located near Kenebri in the Warrumbungle Shire and on "Raeburn" consisting of 1520 ha located 30 km east of Coonamble in the Coonamble Shire. The properties have been purchased over a 20 year period by Jason and Kylie Catts and operated by Jason and Kylie and two full-time employees.

Farm description

Soils, landscape and climate

Soil types are quite varied ranging from sandy loams, red clays and self-mulching basalt. The topography of the land consists of slightly undulating to open plains country, with areas of scattered timber. The annual average rainfall is 600 mm with a slight summer dominant distribution.

Livestock

The seed stock business consists of 400–500 registered breeding females with the aim to produce 100 bulls for sale annually. Steers and cull heifers are taken through to export feeder weights. The cattle trading business focuses on lighter weight cattle grown on to export feeder weights or finished for domestic or grass-fed markets. Numbers are dependent on available paddock feed or stored fodder, this allows for flexibility of stocking rate.

Pastures and/or forages for livestock

All properties have a mixture of native, subtropical and lucerne-based pastures. Both winter and summer forages are grown for grazing with 400 ha of oats or forage barley grown in the winter and 250 ha of sorghum or cowpea grown in the summer. Excess is chopped for silage.

Cropping

Cereal and pulse crops (240 ha) are grown in winter for silage and grain production for on-farm use. The cropping program is designed to produce fodder as well as to set up favourable agronomic outcomes when establishing perennial pastures.

Drought strategies

Like many producers, drought strategies are continually evolving in our operation. To date we have implemented the following:

- 500 head drought mitigation/opportunity feedlot; and
- 3000 t silage bunker capacity to be increased to 4500 t fresh chopped.

This allows flexibility in stocking rates, by running at 70% of stocking rate with breeder cattle and using trading cattle to increase stocking when fodder supply allows. Also, this enables us to store high levels of moisture in the fallow farming country prior to planting to increase the likelihood of successful cropping outcomes.

Goals or business objectives

Supply genetics to beef producers that add value and profit to the beef cattle supply chain. Further, reduce the effects of variable climatic conditions on forage supply. Reduce farm debt.

The swing back to forages

Over the past ten years, Futurity Shorthorns has developed a silage system by direct chopping forage crops to make pit silage to use as part of our annual management of livestock. The benefits of integrating on-farm silage production have been wide-reaching and added a lot of value to many sections of the business.

Agronomic

When direct chopping cereal crops for silage, in our case, there have been several agronomic improvements that stem from cleaning and early harvest. As crops are chopped four to six weeks earlier than if the crop was to be taken through to grain, the chopping process cleans most weeds from the field prior to weeds seeding and allows an earlier start to a fallow period for moisture storage. This early finish to the cereal crop chopped for silage can allow for a sooner subsequent crop or at least better starting moisture than if the crop was to be taken through for grain or hay. In cases where lucerne is undersown in the cereal crop, the early finish of the cover crop once chopped for silage allows more favourable establishment conditions due to reduced weed competition and less draw on subsoil moisture.

Hay-silage comparison

There is little doubt that a mixture of hay and silage feeding is appropriate for most operations although there are some tangible cost savings, improvements in feed quality and proficiency in feed delivery that have led us to include silage as our major component when feeding cattle. As silage is chopped near its peak nutritional value and with reduced losses through the drying and harvesting process, silages are generally higher in digestibility, crude protein, metabolisable energy value and palatability than hay cut from the same crop.

When we compare the cost of making hay versus silage there are some cost-savings on a dry matter base. A common price for silage chopped, carted to the pit, rolled and the cost of plastic to cover is $26/t. The average dry matter (DM) for cereal crops direct chopped for silage is generally 40%, which results in a cost of approximately $64/t DM.

Common hay baling costs $37.50/bale including cutting and raking. With the hay having a dry matter content of 90% brings the cost to $68.75/t for 600kg bales. Plus $5 cartage back to the stack gives a total of $73.75/t DM.

When you take into consideration superior nutritional value, reduced harvest cost and a lot lower risk of crop damage during harvest, directly chopped silage stacks up well. Chopped silage has the advantage of not needing processing when fed through a mixing wagon compared to hay that requires processing. Silage greatly reduces mixing time and wear and tear on machinery. Although, a bale of hay is more mobile than a pit of silage. When the feeding of larger numbers of cattle in confined spaces is required to protect ground cover, silage offers greater time savings.

Environment

Due to operating a seedstock business, we are unable to sell all the stock when drought conditions occur due to not being able to replace them with like quality. Protection of ground cover and pastures are imperative for the sustainability of our country. A well planned on-farm silage system allows weaning of calves at any age and have them moving forward. If conditions deteriorate, breeding stock can be fed in a mitigation feedlot or finished for slaughter, thereby saving pastures from overgrazing and erosion of soil.

Increased profits from silage feeding

I would like to share a few key concepts that by having an on-farm silage system allows producers to do.

Take advantage of highs in the market. Every year there are highs and lows in the market (Fig. 1). By not being totally reliant on the weather for production, producers can have sale stock hitting the market in peak periods or purchase in a soft market.

If there is insufficient paddock feed in the autumn, calves can be weaned early and then by using silage based diets calves are able to gain 1–1.5 kg/day post-weaning until fodder crops are ready to graze. Producers can take advantage of higher prices in late winter-early spring preceding the spring turn-off cattle. This practice greatly reduces the age of turn-off and reduces stocking rates without reducing kilograms of turn-off.

Take advantage of lows in the market. Most years at the start of winter the weaner market is depressed (Fig. 1). Having silage systems in place allows for the purchase of stock at much-reduced rates. Silage based diets can supply high average daily gain (e.g. Table 1) and low cost of gain. Thus making the feeding component of cattle trading profitable even without an upside in the trade, but combining both can bring substantial rewards.

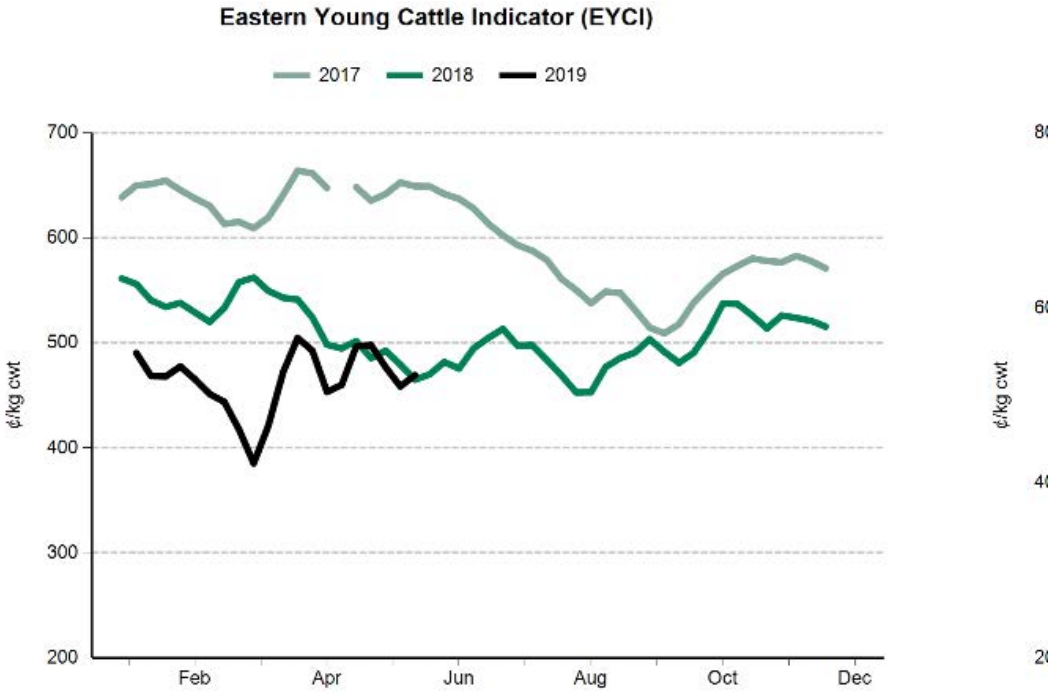

Figure 1. Eastern young cattle indicator demonstrating annual market trends (source: MLA 2019).

Table 1. Steer live weight gain and feed conversion were better on diets based on silage produced from ryegrass/subclover pasture with various levels of concentrate (source: Kaiser *et al.* 2004 adapted from Jacobs and Zorrillo-Rios 1994).

	Hay (5.6 t DM/ha)			Silage (5.0 t DM/ha)		
Concentrate in diet (% liveweight)*	**0.5**	**1.0**	**1.5**	**0.5**	**1.0**	**1.5**
DM intake (kg/day)						
Forage	4.36	3.86	2.82	4.99	4.26	3.58
Concentrate	1.39	2.90	4.47	1.45	2.94	4.39
Total	5.75	6.76	7.29	6.44	7.20	7.97
Liveweight gain						
kg/day	0.33	0.63	0.88	0.81	1.09	1.20
kg/t feed DM	57	93	121	126	151	151

* Concentrate comprised 67% barley, 30% lupins and 3% minerals.

Have the herd ready for breeding. Feeding post-weaned heifers a silage ration ensures they maintain good growth rates and retained heifers reach adequate weights prior to their joining date.

Conclusions

On-farm silage harvest offers agronomic advantages by the way of earlier moisture conservation and reducing weed burden. There are savings in direct chopping silage over hay as well as the increased nutritional value of the fodder and less weather risk during crop harvest. By having the option to rapidly reduce stocking rates in paddocks, a silage system allows protection of ground cover and ultimately reduces soil loss or erosion. Crops or pastures offer lower-risk production. However, by having the option of feeding silage-based diets to young cattle either, bred or purchased, when the season requires can allow producers to take serious market advantages.

Acknowledgments

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Turning traditional cropping farmland into productive grasslands using tropical grasses, multispecies pasture cropping and saltbush

J Kirkby and L Kirkby

"Glenavon", Gravesend, NSW 2401: info@amaruladorpers.com

Abstract: *This paper is about transitioning traditional farming country and degraded native pastures back to healthy productive grasslands. There are several methods that can be utilized including multispecies cover cropping, multispecies pasture cropping and the establishment of tropical grasses. There are many challenges that are faced along the way, but the rewards and the benefits of a healthier ecosystem by swinging back to forages, far outweigh these.*

Key words: soil health, soil biology, groundcover, rainfall use efficiency, Dorpers

Introduction

After the purchase of a small farm in 2004 and the neighbour's farm in 2008, we were the owners of 890 ha of Gravesend farming country, 50 km east of Moree. Both farms were rundown with poor soil health due to constant ploughing, use of chemicals, lack of groundcover and nutritional grasses. Grain cash crops were originally grown, but good profits were usually thwarted by the weather. Our main business was Amarula Dorper Stud, so our objective was to swing our bare soil back to grass. We did try letting nature take its course through grazing, but the country was too degraded, and this method was very slow. We then introduced tropical grasses on farmland and started pasture cropping in the native grassland. Trees and saltbush were the next steps. Inadvertently we began to regenerate soil health and armour the soil for increased rainfall use efficiency and ultimately profitability.

Farm description

- Glenavon has an area of 890 ha and is located 50 km east of Moree, just south of the Gwydir River.
- Our annual average rainfall is 650 mm, usually a summer dominant rainfall with the remaining months providing generally even falls. Summer rain tends to be more variable than winter rain due to the incidence of thunderstorms in summer. The last three years have been very below average and getting worse as the drought continues. Year to date average is usually 310 mm. Our year to date rainfall to June this year has been 97 mm.
- Water access for livestock is excellent with a very good source of bore water that is piped to all 42 paddocks, with a portable trough system. The average paddock size is 15–20 ha. There are dams in some paddocks, but we do not have to rely on these. Our sheep prefer clean bore water.
- There are three soil types ranging from 60% black basalt, 30% red and 10% sandy loam, on a slightly undulating landscape.

Livestock

Amarula Dorper Stud was established in 2000 and is our main livestock enterprise. We breed Dorper and White Dorper sheep. We are currently running 800 stud ewes plus lambs and 300 young rams. Our moderately-sized, easy doing Dorpers are bred to cope in harsh conditions and be resilient to nutritional hardship. They are foragers and will eat bushes and shrubs and if managed properly can improve the species of plants within a pasture.

In the face of increasing climate variability, it is essential to have sheep which can both capitalise on good seasonal conditions but still perform under challenging ones. The Dorper can deposit and then utilise its body reserves when needed and utilise low-quality foods. This increases production rates from fewer inputs but also improves the survival and welfare of animals when faced with the harsh conditions of droughts in Australia. The less seasonal mating of Dorpers also allows producers more flexibility in matching the feed requirements

of the reproducing ewe to feed availability and allows mating systems to be altered according to seasonal conditions.

Pastures and/or forages for livestock

Tropical grasses. First established in 2008, we now have 250 ha of perennial tropical grasses including Premier digit, Bambatsi, green panic, Bisset and hatch creeping bluegrass, Floren bluegrass, and Rhodes grass. To improve the legume content of these tropicals, we have added clovers and medics with the hardiest being snail medics, rose clover and winter dormant old variety lucerne (Flairdale). We are seeing the native glycines flourish. Recently, we have successfully established perennial tropical legumes (Desmanthus) into our tropical grasses.

Native pasture. Our dominant grasslands are native pastures, with varying nutritional quality, including native bluegrasses, redgrass, plains grass, wallaby grass, to name a few. With our farming practices, we have seen native species including grasses, herbs, legumes and other plants returning.

Transitional farming country. We are using our new innovative farming practices on 150 ha to cover crop and turn this into productive grasslands.

Saltbush. We have established saltbush (along with tropical pastures) to increase drought tolerance, increase soil health, shade, shelter and water quality. It is a very drought tolerant plant that and can provide green leaf through the driest periods and especially the autumn/winter feed gap. It improves biodiversity and environmental sustainability. Dorpers thrive on saltbush.

Grazing management of these pastures is through rotational grazing strategies. This improves the flexibility of movement, increases the health of animals, the health of plants and soils and decreases the need for drenching.

Cropping

Conventional cropping methods have been used in the past, with oats being grown for fodder very successfully. But after attending a field day with speakers Colin Seis and Judy Earle in 2006, our quest began to implement new farming methods. We now use no synthetic fertilisers or chemicals.

Pasture cropping. This is done with a single crop species, usually, oats, into a perennial grass base improves soil structure, soil carbon, nutrient cycling and more efficient use of water while producing good crops for forage. This technique has increased our perennial grass species diversity and density while decreasing farming costs and increasing soil health.

Multi-species pasture cropping. This was experimented with when Justin discovered Gabe Brown and Ray Archuleta. This farming system mimics the native pastures where there is diversity, not a monoculture. We now use at least 10 or more different groups of plant species that produce good quality forage and have a range of different root systems. This includes broadleaves, grasses, fibrous and taproots, legumes, flowering plants and others to diversify our fodder cropping system. The greater the diversity of plants the greater diversity of microbes and the more robust and healthier the soil ecosystem.

Multi-species cover cropping. This is essential to rebuild soil health in degraded farming paddocks. The use of multi-species cover cropping will armour the soil, build soil health, organic matter and soil microbes. Once this is established, we can establish our tropical grasses and legumes. We have now eliminated the use of synthetic fertilizers for five plus years and chemical sprays for the last three years. All these methods grow more nutritious forage for our Dorpers. The intention is to split paddocks further, using temporary fences and solar powered gates, to increase the production of live-weight per ha. Livestock are integrated into this system to forage and trample excess herbage into groundcover. In our system, there is no such thing as a weed. We utilise our Dorpers to clean up our farming paddocks to remove spray resistant plants such as fleabane, barnyard grass and others.

Drought strategies

Our main drought strategy is to adjust our stocking in response to the 'rolling rainfall total'

and not rely on the average rainfall. There is no such thing as average. Our climate is getting hotter and dryer. As the 'rolling rainfall total' begins to decrease and forage reserves start to become depleted, destocking becomes the tool to maintain groundcover and conserve fodder in the paddock. Prior to the drought, we were running over 2000 Dorpers and 100 cows and calves. In early 2018 we started a destocking program, which has seen a steady decrease in our livestock numbers. This is to preserve our groundcover for a quick recovery when it does rain. Other drought strategies include early weaning and feedlotting, confined paddock feeding in sacrifice paddocks and more and more saltbush in the future.

Goals or business objectives

Out of adversity, comes opportunity. With the prolonged drought our end goals have changed with profit not production being our main driver. You don't have to be the biggest or the best and produce the most. It is all to do with profit at the end of the day.

Our short-term goal is to make it through this drought and maintaining groundcover and grass. This gives the land the ability to recover and regenerate quickly once the rain decides to fall. We also can take advantage of smaller falls as you need to maintain water infiltration and not let it all run away.

Our medium-term goal is to establish more saltbush in our native pasture country, for more resilience to drought, but also improved biodiversity and increased fodder reserves within the paddock. Also, to continue regenerating degraded pasture and establishing more tropical grasses, increasing organic matter and soil carbon.

Our long-term goal is to have all our land covered by biodiverse grasslands (either native or introduced tropical) along with more trees and saltbush established back on all our land. This leads to better guardianship of our natural resources and producing healthy highly nutritious food and livestock.

The swing back to forages

When we bought our farm in 2004, we were still following conventional farming methods of cropping with oats for fodder and wheat or barley as cash crops. Our soil was very much degraded with a soil carbon of 0.7% and the native pasture was taken over by less nutritious and desirable plants such as wiregrasses, spear grasses and kerosene grass. Most of the soil was scalded bare and brittle. The catalyst for change began as we were not making money from our crops and we needed to improve our pastures for our livestock health. Along came Colin Seis, Judy Earle, Christine Jones, Bart Davidson, Gary McDouall to name a few and in the last four years Gabe Brown and Ray Archuleta. These people have made a huge impact on our swing back to forages and the methods we have adapted to our farm to make these changes.

The initial obstacles to establishing our tropical pastures were the cost of seed and preparation of the soil prior to planting. Luckily, we were successful in obtaining grants from the CMA for seed costs. The biggest obstacle of all with establishing any pasture is rain. In our opinion, the establishment of good tropicals comes down to luck. You can prepare efficiently, but if you don't get the rain and follow up rain, then it can fail. Luckily, we can easily fix our native pasture through the simple use of multi-species pasture cropping.

The biggest opportunity we see for swinging back to biodiverse grasslands is the increasing health of our soil. Better soil health and diverse ecologies build resiliency into our farming operation and improve productivity, but more importantly profitability. Better soil health, higher organic matter and hence carbon increases infiltration rates, increases the water-holding capacity of the soil and therefore ultimately drought proofs a property. Our methods of farming have made it possible to weather most dry periods, while still being productive. There will be other droughts and next time we will have built resiliency into our natural resources with our management practices.

The future

The future is exciting. We have just won the North West Landcare award for excellence in farming for 2019 and go to the State final in October. This

gives us acknowledgment that we are on the right path. Our journey into regenerating our soil, plants and land doesn't stop now. Yes, we have been successful using new farming techniques and sustainable agricultural practices with the positive outcomes of improved environment and profitability. However, we are still learning and educating ourselves to look for more efficient methods of establishing grasslands.

Conclusions

Swinging back to forages and grasslands has been the most important change and challenge to our farm. The drought has tested our farm, soil and vegetation. We have still been productive but have had to destock and feed grain to remaining Dorper Stud Ewes while they are lambing, to retain our ground cover and recovery ability of our ecosystem. We will continue our journey and learn from failures and trial better establishment methods of tropical and native grasslands in our transitional farming country. Ultimately, the end goal is leaving our grasslands and other natural resources better for future generations.

Poisoning of lambs on mature Bambatsi panic (*Panicum coloratum*) pasture

SM Slattery

North West Local Land Services, Narrabri, NSW 2390: shaun.slattery@lls.nsw.gov.au

Abstract: *In March 2018 the author investigated the deaths of 140 from 1400 Dorper lambs in the Wee Waa district of New South Wales. The deaths occurred after the lambs were introduced to tall, mature Bambatsi panic (*Panicum coloratum*) dominated pasture. The lambs had clinical signs, gross pathology and liver histopathology consistent with saponin toxicity. Photosensitisation was largely absent. Ewes also grazing the pasture were not affected. While the pasture was flowering at the time of the poisoning it is suggested that the lambs preferentially grazed new shoots from recent rain. Grazing management recommendations to avoid similar pasture circumstances were implemented with no further cases in the following 12 months. The lack of photosensitisation and age-related susceptibility is discussed.*

Key words: saponins, photosensitisation

Introduction

Steroidal or lithogenic saponins are a relatively common plant toxin poisoning of ruminants in New South Wales (NSW). Common sources of saponins in NSW include *Panicum* and *Tribulus* spp. Regault (1990) reports a case in sheep grazing Bambatsi panic (*Panicum coloratum*) in the Goondiwindi region of Queensland. McKenzie (2002) lists both Bambatsi panic and Gatton panic (*Megathyrsus maximus*) as sources of saponins, and Bambatsi panic as an important species for poisoning. Both of these grass species are commonly sown in pasture mixes in northern NSW (Harris *et al*. 2014). Saponins cause crystal-associated cholangiohepatopathies and secondary photosensitisation. McKenzie (2002) indicated poisoning commonly involves young ruminants, especially lambs grazing stressed pastures or crops.

This paper reports an investigation into saponin poisoning in black-headed Dorper lambs following introduction to mature Bambatsi panic dominated pasture on a property in the Wee Waa district of NSW in March 2018.

Pasture description

Two adjacent 30 ha paddocks were sown in March 2017 with a Bambatsi panic, Gatton panic and Premier digit grass (*Digitaria eriantha*) mix. Due to conditions at pasture establishment, by the time of poisoning, the pasture consisted of predominantly Bambatsi panic. A small area of *Tribulus* spp. was present in one paddock but largely absent in the other.

At the time of poisoning the pasture was mature, 40–70 cm high and setting seed. Examination of the paddocks showed heaviest grazing of the Gatton panic, followed by Bambatsi panic. The digit grass was least grazed. These observations suggest the sheep had preferentially grazed the Gatton panic, then the Bambatsi panic. In the one paddock where *Tribulus* spp. was present, this had been heavily grazed suggesting that it had also been selectively grazed by the sheep. Perhaps critically, at the time of introduction, there had been 40 mm of rain. As a result, all grasses were actively growing, and new green shoots developing. At the time of paddock inspection, this green regrowth from the base of the plants appeared to have been preferentially grazed. The older longer leaves were generally ungrazed.

Case presentation

The black-headed Dorper lambs were from two mobs, grazing the two adjacent paddocks. One mob consisted of 500 weaned lambs aged 4–8 months. The other mob consisted of 700 Dorper ewes and 900 unweaned lambs aged 4–8 months. The history and grazing management of both 30 ha paddocks was similar and both mobs were introduced to their respective paddocks on the same day.

Deaths were first noticed 10 days after introduction to the pasture with 24 dead lambs. When the deaths commenced was unclear, as the mobs had not been checked since introduction. However, the degree of carcass decomposition suggested the first deaths had occurred 5–8 days after introduction. The sheep were immediately removed from the pasture.

At 13 days after introduction 50 lambs had died and another 80–90 were clinically affected. By 20 days after introduction 90 lambs were dead and 40–50 clinically affected. Deaths continued for two months and eventually almost all clinically affected lambs died (c. 140 lambs). All dead or clinically affected lambs were in the initial clinically affected group. Both mobs of lambs were affected at similar rates. No ewes were observed with clinical signs.

A property investigation was undertaken when deaths were first observed. This included an examination of clinically affected lambs, an autopsy and paddock inspection. Treatment consisted of immediately removing all sheep from the paddocks and placing the lambs in a well-shaded paddock with only dry grasses. The ideal treatment of removing from any direct sunlight was not possible due to the absence of a suitable shed.

Clinically affected lambs showed lethargy, shade seeking and yellowing of mucous membranes. Photosensitisation was not a prominent feature (possibly related to protecting black skin).

The autopsy found extensive yellowing of all tissues and a swollen orange liver. Tissue samples were submitted to the NSW Department of Primary Industries State Veterinary Diagnostic Laboratory. Liver histopathology was consistent with saponin poisoning but pathognomic crystals were not identified. This was potentially due to slight autolysis of samples. No other possible causes of the clinical signs and gross pathology were identified.

Discussion

The classic reported conditions for saponin toxicity of Bambatsi and other panic pastures are grazing short pasture that is actively growing, especially if it subsequently becomes moisture stressed (McKenzie 2002). These were the circumstances for an earlier poisoning incident (10 dead, eight clinically affected from 220 Dorper lambs) that occurred on the same paddocks in December 2017. To manage the risk of future poisonings the owner elected to restrict future grazing by lambs to only mature pastures.

In contrast to these classical circumstances, the March poisonings outlined in this paper demonstrated that poisoning of lambs grazing flowering stands of Bambatsi panic was possible. The observations suggested poisoning can occur if the pasture was actively growing and lambs were able to preferentially graze regrowing shoots. It also demonstrated that poisoning can occur without the pasture showing visible signs of moisture stress.

The role of Gatton panic in this poisoning incident was difficult to quantify. While preferentially grazed, Gatton panic plants were less than one in 20 plants, and as such would have been a small part of the diet. McKenzie (2002) did not categorise Gatton panic as an important species for poisoning. In contrast, Bambatsi panic was categorised as an important species and it was the major component of the grasses observed to have been grazed.

To manage the risk of future poisonings on Bambatsi panic dominated pasture, the following measures were recommended:

- Only graze lambs on mature pasture that is not actively growing;
- Remove sheep from the pasture following rainfall;
- Initially, graze actively growing pasture with ewes to remove green shoots;
- Not grazing lambs until 2–3 weeks after any rain; and
- Grazing lambs at high stock densities to reduce the potential for lambs to preferentially graze any new green shoots.

These measures were successful in preventing poisonings for the following 12 months, but this coincided with severe drought conditions when there were few rainfall events.

The absence of photosensitisation as a prominent clinical sign in a case with significant mortalities was unusual but consistent with the current understanding of secondary photosensitisation as a result of hepatic damage from toxins. This finding suggests it is not photosensitisation that kills most lambs with saponin poisoning but rather liver damage. Moreover, in this case,

the black pigment covering the head of black-headed Dorpers most likely protected the lambs from photosensitisation.

Dowling and McKenzie (1993) summarise photosensitisation as the heightened sensitivity of the skin to sunlight. Secondary photosensitisation occurs when liver damage interferes with the liver's ability to deal with phylloerythrin, a breakdown product of chlorophyll. Phylloerythrin then escapes into the circulatory system and lodges in the skin making it sensitive to sunlight.

Seawright (1989) indicated that this sensitivity damages cellular membranes with enhanced capillary permeability, cell necrosis, vascular occlusion and acute inflammation. The areas of sheep most affected are the ears, eyelids, face lips and vulva. Reddening and oedema result, with rubbing and shade seeking. In lambs, ears droop and the muzzle is swollen. Necrosis of skin can be seen in severe cases.

Bourke (2011) indicated that severity of photosensitisation is not related to individual or species differences in metabolising the offending compounds. Rather tolerance is related to an animal's ability to prevent sunlight from reaching the blood vessels in its skin. Thus variation in tolerance is related to skin thickness, thickness and density of hair or wool coat and the degree of pigmentation in the skin.

The lambs, in this case, were black-headed Dorpers a breed with deep black pigmentation of the head and upper neck. This pigmentation likely prevented the most sensitive areas from being affected with the photosensitisation that is typical of saponin poisoning. However, shade seeking was a prominent feature of the affected lambs.

Further, death in secondary photosensitisation cases is not usually caused by the photo-sensitisation but rather the damage to the liver by the toxin (Seawright 1989). Thus in this case, while the lambs showed few signs of photosensitisation besides shade seeking, the underlying liver damage from the saponins was sufficient to cause death.

The susceptibility of lambs and the absence of poisoning in adult sheep with *Panicum* spp. was noted by Button *et al*. (1987). They also indicated that age-related susceptibility has been used as a management tool for grazing of *P. coloratum*. In contrast, in both the author's experience and Button *et al*. (1987) saponin poisoning from *Tribulus* spp. affects sheep of all ages.

The literature fails to explain this strong age-related susceptibility. In general, younger sheep are more susceptible to toxicities due to differences in ruminant metabolise and general resilience. However, this does not explain the strict immunity of adult animals to *Panicum* spp. poisoning. The selective grazing, in this case, raises the possibility that differences in grazing behaviour may contribute to this age-related susceptibility.

Overall the risk factors for poisoning, in this case, are likely to have been actively growing pasture, the potential for selective grazing of new shoots and grazing of lambs. The grazing management measures outlined earlier may be sufficient to manage these risks, and thus future poisonings on *Panicum* spp. dominated pastures.

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