Direct and indirect effects of resilient pastures at farm scale

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Background

I farm a 550-ha property at coastal Whangarei Heads, Northland, in partnership with my wife Helen. While some land has been in family ownership since the 1850s, our farm has grown over the years through land and farm acquisitions.

The farm consists of a dairy platform of 220 ha and 330 ha of dairy beef and dairy support. The farm is kikuyu dominant and summer dry with rainfall varying between 650 and 1100 mm per annum (Figure 1).

Summer cropping, in-shed meal feeding, sowing Italian ryegrass and kikuyu mulching are all practices used with the aim of running a sustainable system. Perennial ryegrass pastures have limited persistence and are no longer a focus as more resilient pasture species and varieties are sown.

Experience with pasture species in the far north

The past 40 years, and observations from farming cycles prior to that, have demonstrated the cyclical nature of our farm ecosystem. We have regular dry summers, wet but warm winters (Figure 1), and a variety of soil types add to the challenge.

Dry summers are not new (Figure 2) and over the last 50 years perennial ryegrass pastures have struggled to persist. We have continued to experience lacklustre results from various modern perennial ryegrass cultivars including their associated endophytes. Perennial ryegrass is a 'short term' option, lasting only 3 or 4 years before kikuyu becomes dominant again (Paton & Piggot 2009).

Despite the potential benefits of endophyte, the

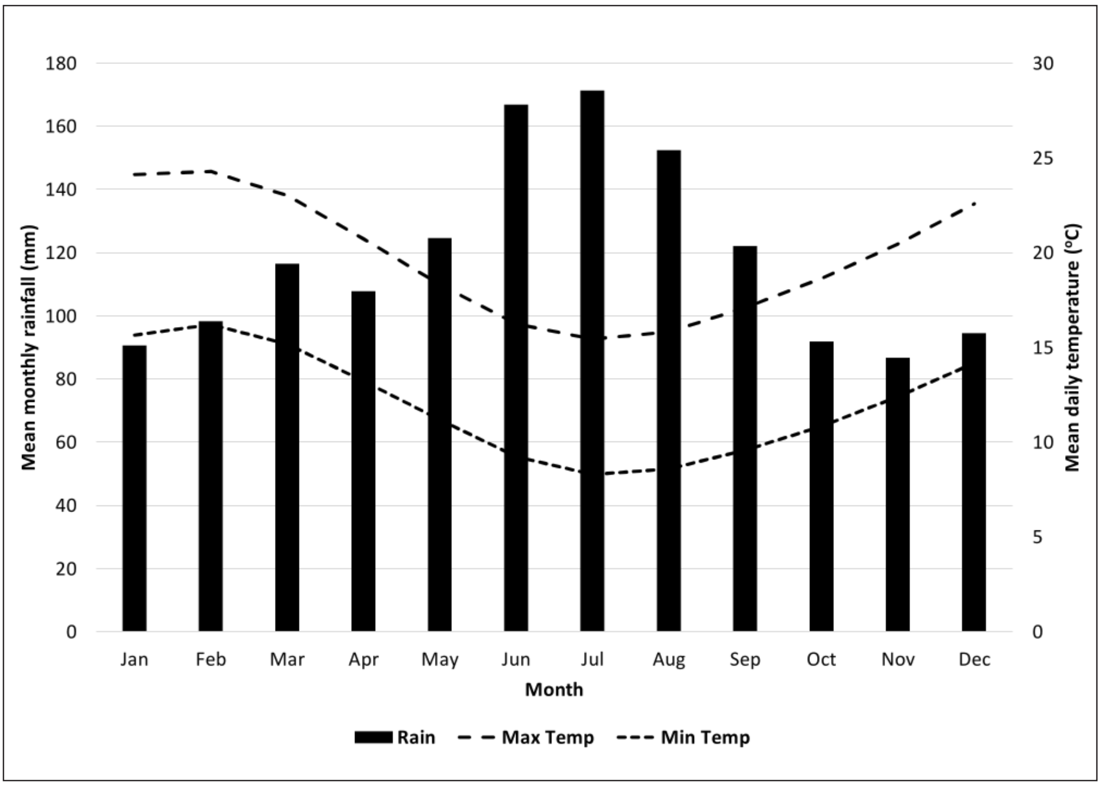

Figure 1 Mean (1960-2020) monthly rainfall, and daily maximum and daily minimum temperatures for Whangarei Heads, Northland. Source of data: National Institute of Water and Atmospheric Research (NIWA), Virtual Climate Station (Tait et al. 2006).

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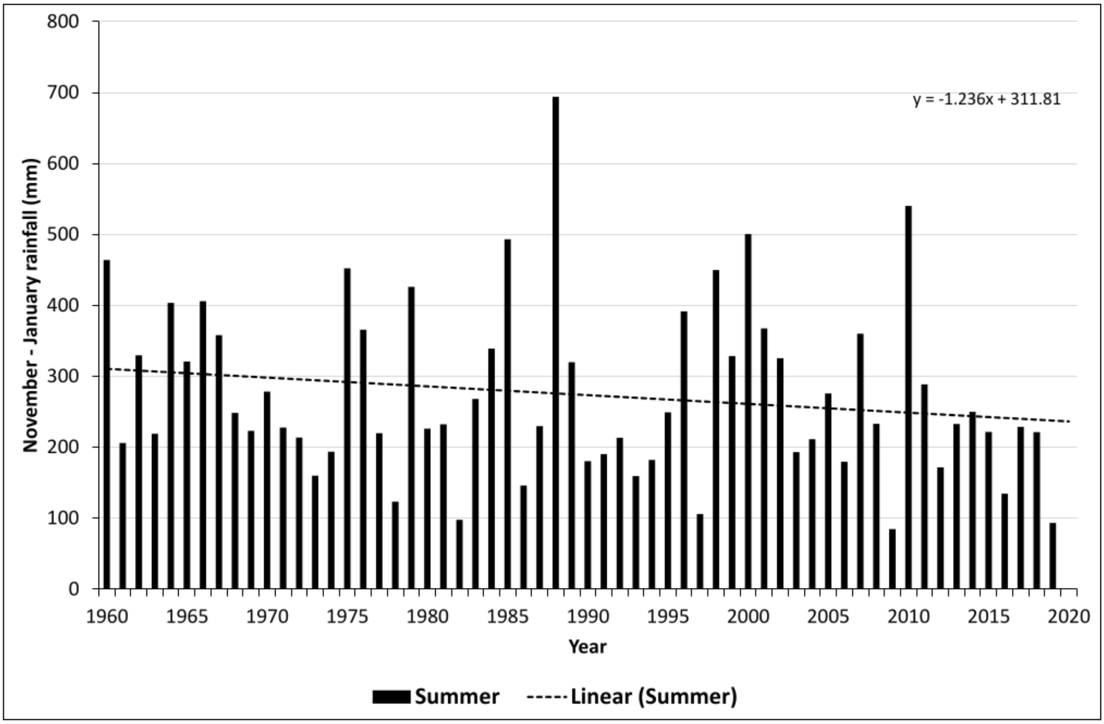

Figure 2 Summer rainfall (November to January, inclusive) at Whangarei Heads, Northland, from 1960-2020 (mean = 271 mm; range = 84-694 mm). Source of data: NIWA, Virtual Climate Station (Tait et al. 2006).

agronomic advantages of improved persistence are not consistently expressed. Climate conditions suggest that summer-autumn extreme dry/drought has been a major factor limiting persistence (Jagger 2009). Perennial ryegrass has a shallow root system (Dodd et al. 2011), especially in compacted soils (Crush & Thom 2011), which makes it susceptible to drought. This results in poor summer growth which in turn can increase susceptibility to insect damage, pulling damage and weed ingression in pasture (Clark 2011).

The seasonal climatic variation and the lack of persistence of temperate species has led us to explore management techniques which allow us and other farmers to benefit from our naturally resilient subtropical kikuyu pasture. This is achieved by applying improved management practices and the use of annual species (e.g., Wynn et al. 2011) along with other resilient pasture species to achieve high levels of milk and beef production.

In the early 1980s kikuyu was not seen as a viable economic option for providing a sustainable, high-performing pasture for the future. Nor was it seen as a desired pasture species compared with perennial ryegrass. Triple mixes became the new focus to combat the seasonal challenges (Johnson et al. 1994). These triple mixes of cocksfoot, tall fescue and phalaris never really took off and the resulting legacy of the negative management effects of some of the old varieties is still holding farmers back today.

On our farm we have persevered in finding resilient alternatives to perennial ryegrass in conjunction with implementing best practice kikuyu management (Jagger 2009). The identification and selection of new cultivars of tall fescue and cocksfoot has been a game changer toward the replacement of perennial ryegrass in our farming system and, I would suggest, the future with a changing climate.

Northland and Waikato regions have climates not always conducive for ryegrass to persist without seedling recruitment. Milne (2011) recognised that tall fescue and cocksfoot had higher survival after drought, due to deeper roots (tall fescue), increased root thickness and mass (tall fescue and cocksfoot) and reduced transpiration rate (tall fescue). So, it is not surprising that tall fescue and cocksfoot persist better than perennial ryegrass in our farm system.

Whilst there are a number of management tools, and various herb and crop varieties to use to make pastures more resilient, my focus will be on cocksfoot and tall fescue pasture mixes as a truly resilient pasture alternative. Many of the problems that are identified with tall fescue and cocksfoot mixes stem from treating them like a traditional perennial ryegrass sward and their particular growth pattern is not matched with appropriate management. Grazing interval is often too long when the plants are actively growing and the plants are often grazed too frequently during a drought when other pastures are stressed. The result of these two failings is that quality is lost, and plant population declines, respectively.

It takes intentional management by farm staff when managing and grazing a multi-species mixture. Understanding growth patterns and grazing timing are critical to a productive resilient system using cocksfoot and tall fescue, so unlearning some of the old industry principles is important. Becoming more dynamic and fluid in grazing management is the new normal.

The resilience benefit

The true value of resilient pastures comes from growing and utilising a greater level of high metabolisable energy (ME) pasture over the season than our current perennial ryegrass pastures and ensuring that the farm can grow pasture through times of climatic pressure. We have evidence on our farm of increased pasture production with our resilient pastures, not only under adverse climatic events, but also a greater contribution to overall pasture production and the ability for a higher stocking rate to be carried longer during deficits and until pasture growth exceeds demand. Livestock prefer to graze cocksfoot and tall fescue pastures over anything else while they are in their optimal grazing condition. This grazing preference is even more pronounced if there is no endophyte involved. The outcome of grazing preference is also rewarded with consistently higher milk volumes.

These resilient pastures also have the ability to generate three times the clover population compared with our traditional perennial ryegrass pastures. This is primarily due to the less aggressive establishment of the pasture sward compared to our perennial ryegrass pasture mixes where modern, high-yielding ryegrass cultivars shade out the emerging clover seedlings. By comparison, clover plants can establish at the same rate as the tall fescue and cocksfoot when they are mixed. A noticeable side effect of the extra clover population is what appears to be greater nitrogen (N) fixation and a reduced need for manufactured N fertiliser application.

Another advantage that we are observing in our resilient pastures is the preservation of soil structure due to their deeper, thicker roots and greater root mass. Where perennial ryegrass swards allow the soil to open, dry out and crack, creating large voids and soil movement, the cocksfoot and tall fescue swards do not open up unless the conditions are extreme. This holding of the soil structure not only maintains moisture but reduces cricket infestation and soil erosion. These are significant environmental benefits. If we then take this further, we are achieving a significant part of what the 'regenerative agriculture' system is trying to achieve using a conventional pasture system.

Because of their stronger root systems and root mass we are also seeing the tall fescue and cocksfoot plant populations competing for the available ground space, which in turn creates stronger competition against weed infestation and kikuyu reversion. Where we have seen an aggressive water efficient plant like kikuyu occupy open ground space as the perennial ryegrass plant dies, we are not seeing the same for the more resilient pastures. In fact, we are observing the reversion process after renewal taking 4-7 years with the resilient pastures compared with 2 or 3 years with ryegrass pastures (Paton & Piggot 2009). This longer reversion interval is creating challenges deciding which paddocks drop out for a summer cropping programme because they are still very productive compared with paddocks that had been in perennial ryegrass. This begs the question, do they really need to be cropped and do we really need to cultivate soil, with reduced cultivation matching another principle of regenerative agriculture? Resilient pastures are giving us more options, which helps maintain a resilient farm system.

Animal performance was touched on earlier in the paper regarding extra milk yield, but there are more benefits. The preferential grazing noted earlier is beneficial to the overall health of the animal, whereby if we are observing extra production, we should be seeing extra weight gain also. There is the added benefit of reduced plant litter present during the autumn, potentially reducing the risk of facial eczema.

Grazing management is critical to the success of both the production and quality extracted from the pasture but also the survival of the pasture sward. New management skills need to be developed and disseminated with farm staff to ensure they use management principles for resilient pastures. The positive effects of this on staff well-being through dry periods should not be underestimated. Having pasture species which are more resilient during climatic challenges and having the ability to feed livestock through those challenges is important for morale and reduces stress on both farm staff and livestock.

Our pasture future

Modern cocksfoots and tall fescues seem to be our best option for building a pasture base that is more resilient to the climatic challenges we are facing in Northland. I would suggest they also can be regenerative in our farming systems. They will be the key platform for our grazing systems for at least the next 30 years as we adapt to the changing climatic dynamics. Farmers who have tried old varieties of cocksfoot and tall fescue and have experienced the negative management traits, need to try again. Farm management practices must adapt to be more vigilant, dynamic and fluid to ensure the optimal grazing intervals for defoliation are achieved for improved survival of these resilient pastures.

There is no doubt we have gone down the wrong rabbit hole over the past 40 years chasing persistence with a plant that was never completely adapted to our environment. All this time we have had resilient pasture species in our toolbox but only now are we seeing the true productive, environmental and economic value of them. Perennial ryegrass and endophyte development provides some good tools for the majority. But it is time to look at the future.

These two new words of resilience and regenerative should now be our primary focus to ensure our farming systems remain profitable, sustainable and environmentally compliant.

Conclusions

I will end this paper where I started, going back 40-50 years. A generation ago most farms made hay for winter feed. During that process the perennial ryegrass plants produced seed which regenerated the seed supply in the ground and the cycle started again. The plants died over the dry summer, the cracks appeared, which the crickets occupied, and we killed those with malathion-treated bait.

For the last 40-50 years, farmers have complained about lack of perennial ryegrass persistence. They have stopped making hay. Plant breeders have bred aggressive, high-yielding and late-flowering perennial ryegrass plants and farmers have responded to that by increasing the farm stocking rates to eat the more aggressive plant. But the perennial ryegrass plant is still a perennial ryegrass plant with the same root structure and growth characteristics. Adding an endophyte makes it resistant to some insects but still not resilient in some environments.

The next 30 years should see an intense focus on having farm systems that are profitable, sustainable and resilient to all the challenges including environmental and climatic. A greater focus on our current cocksfoot and tall fescue pastures that are proving themselves as resilient and regenerative, along with their ability to provide environmental benefit particularly around soil degradation and moisture retention, is critical. Seed companies need to ramp up research and development around true resilient and regenerative pastures to allow for our changing climatic ecosystems including our resident subtropical plants.

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