A snapshot of pastures in the mixed-farming zone

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Abstract
A pasture survey of 54 paddocks was conducted with 17 Farmlink members in southern NSW. The purpose of the survey was to determine how pastures were managed and which pasture species were sown. An assessment of the paddock then compared the sown species to the species growing in the paddock. In total across the farms, 15 species were sown, but lucerne and subterranean clover were the dominant species being sown in greater than 80% of paddocks. The average frequency in which these species were found was greater than 60% but with large variation among paddocks. Sown species produced 62% of biomass on average across all paddocks. Unless the frequency of a species in the paddock was at least 50%, then the contribution to production of that species was low (<20%). Using the frequency benchmark of 50% it could be demonstrated that pasture composition commonly includes only 2-3 of the sown species.

Keywords
Lucerne, subterranean clover, undersowing, pasture establishment, grazing.

Introduction
Pastures within mixed-farm regions support 55% of the Australian sheep population and are integrated on farm with arable crops in a rotation system (Pratley and Virgona 2010). Commonly, pastures are short-lived in comparison to the higher rainfall areas with permanent pastures. Pastures on mixed-farms have multiple benefits for growers. Not only do they support approximately 57% of the annual feed supply (McCormick et al. 2012), they also provide significant levels of nitrogen for following crops as well as opportunities for disease and weed breaks. For this reason, mixed-farms with a focus on cropping have only seen the pasture phase as an important step to get back into cropping. There has been a release of a range of new annual legumes for the mixed-farming zone to address conditions where subterranean clover has poor adaptation (Nichols et al. 2007). New sowing techniques for hard seeded legumes have also been developed including twin sowing and summer sowing (Hackney et al. 2015). How these species respond in mixtures and under grazed conditions has been little researched. McCormick et al. (2012) identified that adoption of these species was low in southern NSW. One problem consistently identified with pastures on mixed-farms is the lack of persistence, although the same farmers commonly judged their pastures as being good (McCormick et al. 2012). Objective methods of assessing pastures on mixed farms are lacking which leads to subjective assessments determining on farmer decisions.

Methods
Fifty-four pasture paddocks on 17 farms were surveyed in late spring 2016. Interviews were conducted on each farm to determine the species that were sown and the agronomic management for each paddock. This included method of pasture establishment (straight sown vs. undersown), weed management (winter cleaning/spray topping), fertiliser use and grazing management. The pasture paddocks were surveyed by walking diagonal transects across the paddock with pasture assessments occurring in 50 sampling positions that were approximately evenly spaced. At a sampling position approximately 0.25 m^2 of pasture was assessed by two methods. First, the frequency of the sown species was determined. This assessment simply involved noting whether the sown species was present at each sampling position and expressing the answer as a percentage of all sampling positions within a paddock. Second, the three species with the highest estimated biomass were ranked to determine pasture composition using the dry weight rank technique at each sampling position (t'Mannetje and Haydock 1963).

Results
Average paddock size was 44 ha with a range of 10-112 ha. Seventy percent of paddocks were established via undersowing with the rest established either by straight sowing of autumn pasture or summer sowing hard seeded legumes. Seventy nine percent of paddocks had had some weed control by winter cleaning or spray topping during the pasture phase and top dressing with super phosphate was undertaken on 46% of

paddocks. Grazing management was predominantly set stocked (70% of farmers) from winter to harvest time even though definition of rotational grazing used was very broad.

Fifteen species were included in pasture mixes on farm. Lucerne (*Medicago sativa* L.) and subterranean clover (*Trifolium subterraneum* L.) were sown in more than 80% of paddocks. The next most common species were arrowleaf clover (*Trifolium vesiculosum* L.) and annual medic (*Medicago spp.*). The number of species sown in a pasture mix ranged from one to six species and commonly multiple cultivars of subterranean clover were included.

Table 1. The number of paddocks sown to a pasture species and the frequency and percentage of pasture composition.

	Percentage paddocks sown (%)	Frequency of sown species (%)		Composition of biomass (%)	
Species		Average	Range	Average	Range
Lucerne	87	65	0-100	27	0-73
Sub clover	81	64	0-100	20	0-74
Arrowleaf clover	35	40	0-94	11	0-44
Annual medic	31	15	0-78	3	0-34
Balansa clover	19	82	50-100	30	1-79
Cocksfoot	17	45	0-96	10	0-30
Bladder clover	15	44	0-90	5	0-21
Phalaris	11	44	0-88	18	0-43
Gland clover	9	89	78-96	21	5-35
Biserulla	7	50	2-94	36	0-73
Chicory	4	12	0-24	2	0-5
Tall fescue	4	85	72-98	26	13-39
Rose clover	4	79	70-88	29	6-51
White clover	2	0	na	na	na

The average frequency with which lucerne and subterranean clover was found in the pastures was 65% and 64%, respectively, although the range was 0-100% for both species. Other species that were commonly sown included arrowleaf clover, annual medic and balansa clover (*Trifolium michelianum* Savi.) had average frequencies of 40%, 15% and 82%, respectively, but they also had very wide ranges. Other species that had high frequencies included gland clover (*Trifolium glanduliferum* Boiss.) and tall fescue (*Festuca arundinacea* Schreb.); although these were present in a much smaller number of paddocks and thus frequency may not well represent their average performance in the region. On average, lucerne and subterranean clover provided 27% and 20% of the biomass, respectively, with ranges from 0-74%. For other less commonly sown pastures, the averages are less helpful. However it appears that they can be highly productive under certain conditions, but that they can also sometimes produce very little biomass. Across all paddocks, sown species contributed on average 62% of the biomass, but this ranged from 11-89%. If the species are broken down into functional groups then perennial legume (lucerne) provided on average 27%, annual legumes 39% and perennial grasses 26% of the biomass in the paddocks in which they were sown. It should be noted that included in annual legumes group was the naturalised hard-seeded clover clustered clover (*Trifolium glomeratum*) which was very prominent in some pastures in 2016. Annual grasses formed the largest weed component at 31% of biomass with broadleaf weeds less at 5%.

If we compare the frequency of an individual species with the contribution that it makes to biomass for the same paddock, there is an increasingly wide range of biomass produced (Figure 1). These results indicated that species can have a high frequency but contribute very little to production. However, Figure 1 also indicated that if the frequency of a species was less than 50% there is no potential for it to make a meaningful contribution to pasture production (approx. 20%). If a sown species was to provide greater than 50% of the biomass than it would be required to have a frequency of at least 80%.

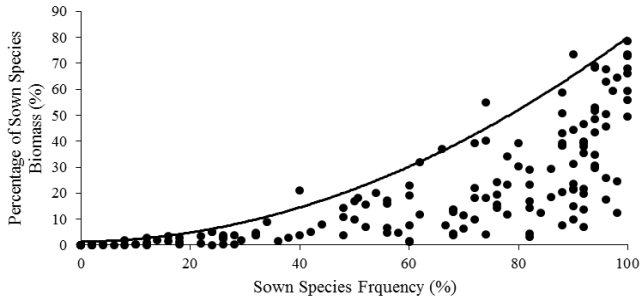

Figure 1. The effect of species frequency on biomass production. Line plotted by eye to demonstrate upper limits of production ($y = 0.7634x^2 + 0.0237x + 0.0132$).

In terms of the number of species sown compared to the number found in the paddock, there was a small decrease in the number of species (Figure 2a). If we only considered those species that had a frequency higher than 50% then the number of sown species persisting in the pasture decreased greatly compared to the number of species originally sown. Figure 2b demonstrated that pastures commonly only had 2-3 sown species that contributed significantly to pasture production.

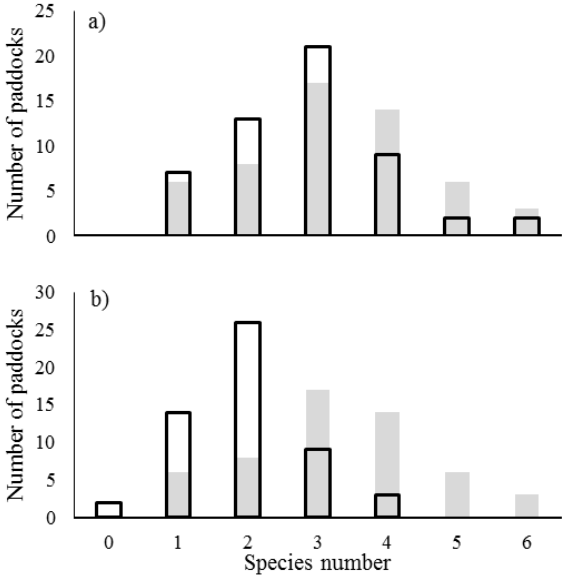

Figure 2. Comparison of number of sown species (grey bars) compared to a) the number of sown species found in the paddock (open bars) and b) the number of sown species with greater than 50% frequency found in the paddock (open bars).

Discussion

The survey demonstrated that a large number of pasture species were sown on farm, but that lucerne and subterranean clover continue to be in most pasture mixes. The common use of annual medics was surprising, but many conversations indicated that annual medics were considered by farmers as more reliable in setting seed than subterranean clover; although there were not many paddocks where annual medics contributed significantly to biomass. The newer aerially–seeded annual legumes tended to be added into conventional pasture mixes, except a small number of paddocks that had been sown with hard seeded legumes in summer. All species in the list (Table 1) can be productive in this environment (except white clover), but specific species should be sown for a purpose and managed appropriately. Only a few species will be productive out of "shotgun mixes" and reducing the number of species sown may enhance the productivity of the species that are sown by reducing competition during pasture establishment. Similarly, Virgona and Hildebrand (2007) demonstrated that pastures in the higher rainfall zone reverted to 2-3 sown species within a short time after sowing. Management of the aerially-seeded species in pasture mixes has not been well researched. Brownlee and Scott (1974) suggested that establishing pastures by undersowing was a two year process in which to accumulate sufficient seed. Grazing in the second year after establishment is likely to heavily penalise aerially seeding species compared to subterranean clover.

Lucerne rightly continues to be an important species in the mixed farming zone. Most pastures were set stocked for long periods of the year despite decades of research demonstrating that lucerne persistence decreases dramatically under set stocking (Lodge 1991). If lucerne is to be productive and persistent, significant rest periods need to be enforced. Many conversations with farmers indicated a resistance to rotational grazing. In addition, the large size of paddocks and spread of pasture paddocks across farms make rotational grazing very difficult. Saul and Kearney (2002) believed that paddocks greater than 20 ha reduced potential stocking rates in the high rainfall zone. There has been no research in the mixed farming zone to determine the effect of paddock size on stocking rate. With the advent of GPS guidance, many farmers have redesigned their farms with little consideration given to the potential losses for livestock production: this has reinforced their views that livestock enterprises were not as profitable as cropping. On mixed farms, planning for pastures needs similar consideration as that for cropping to ensure pastures are productive and efficient.

One problem with improving pasture performance is a lack of benchmarks. McCormick et al. (2012) demonstrated that most farmers believed that their pastures were good, but those same farmers also indicated that persistence was the largest issue. Frequency could be a simple tool used on farm to determine productive potential of the pasture. Simple tools need to be developed to enable farmers to make informed decisions of pasture performance.

Conclusion

Farmers sow a wide range of species in their pastures, but lucerne and subterranean clover continue to be the dominant species. The frequency of a species in a pasture needs to be greater than 50% for it to contribute significantly to pasture biomass. Generally, only 2-3 sown species were found with a frequency greater than 50%. Although lucerne is commonly sown, very few farmers rotational graze it as required.

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