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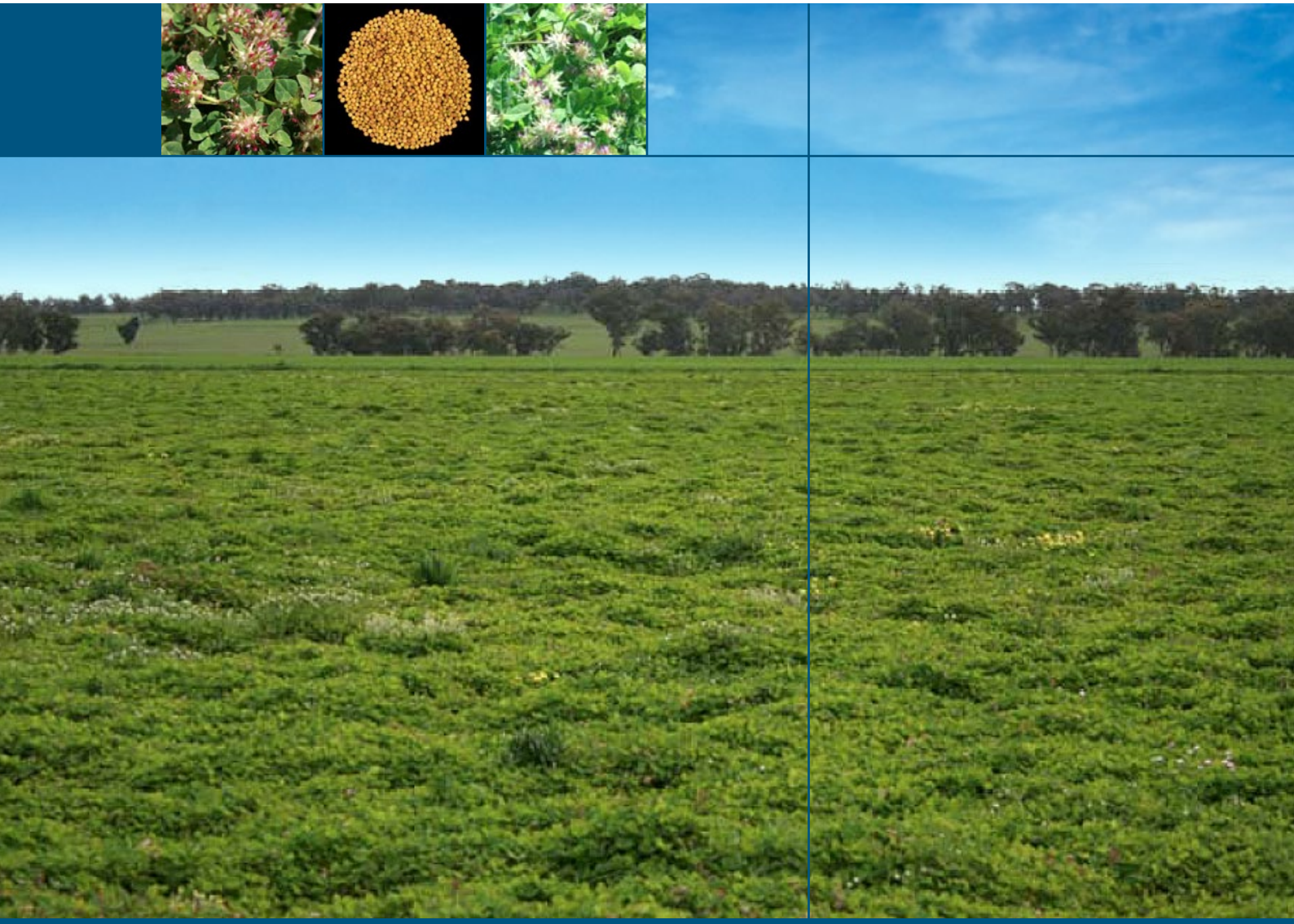

Using bladder clover to increase crop and livestock production

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Foreword

Pasture legumes have long been the backbone of pasture and crop production systems in NSW. Traditionally, this role has been fulfilled by annual legumes such as subterranean clover and various medic species. While these species were widely successful, they do suffer from some limitations including shallow root systems which restrict their ability to survive moisture stress particularly in spring which can result in poor seed set. Additionally, false breaks in autumn can seriously deplete seed banks. Drought and highly variable seasonal conditions in NSW have resulted in the depletion of these species in NSW.

New annual legume species development over the past 20 years through programs such as the National Annual Pasture Legume Improvement Program (NAPLIP), have resulted in the development of a diverse collection of annual legume species with high potential for NSW farming and grazing systems. The ability of these new legumes to provide answers to legume loss and therefore poor pasture and crop productivity is very promising. One of the most exciting attributes of these new legumes is their ability to give farmers greater flexibility in their crop-pasture rotation systems. The productivity and reliability of these new legumes has been shown through recent drought years in NSW in comparison to traditional legumes.

Bladder clover is one of the new generation of annual legumes which has significant potential in NSW farming systems. Bladder clover has proved to be an exceptionally hardy species in recent drought years in NSW. One of its strongest attributes is its propensity to set seed even under very adverse growing conditions. Coupled with this is the ease of harvest – farmers growing bladder clover have produced up to 1.2 t/ha of direct header harvestable seed. Bladder clover has performed well in conventional pasture establishment systems practised in NSW and also shows potential for use in the newly developed twin sowing strategy. The hard seed attributes of bladder clover make it equally well suited to use in self-sustaining crop-pasture rotations or as a component of longer term pastures. Combined strategically with other recently developed hardseeded annual legumes, NSW farmers now have new tools to assist them in maintaining and increasing pasture and crop productivity.

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contents

Introduction 4

Bladder clover in Australian agriculture 5

Farmer experience with bladder clover 15

Introduction

Origin of bladder clover

Bladder clover (*Trifolium spumosum*) is an annual legume native to the Mediterranean areas of Eurasia. In its native range, bladder clover is commonly found growing in association with other annual legume species such as subterranean clover (*Trifolium subterraneum*).

Bladder clover has only recently been domesticated. In 1987 germplasm of naturalised bladder clover was collected from near Melini in Cyprus by Dr. C. Francis, D. Drousiotis and A. Della. This material was subsequently imported into Australia where it underwent development in the National Annual Pasture Legume Improvement Program (NAPLIP) resulting in the release of the world's first commercially available cultivar of bladder clover in 2007.

Plant description

Bladder clover is a semi-erect annual legume which can grow up to 50cm tall. It has trifoliate leaves (three leaflets per leaf) which are hairless and produces flower heads that are pale pink in colour. The flower head of bladder clover can contain up to 150 seeds. Seeds are yellow to light brown in colour (Figure 1). There are approximately 500,000 seeds per kilogram with individual seeds weighing about 2mg. In comparison, subterranean clover contains on average 300,000 seeds per kilogram.

Bladder clover has proved to be better at producing herbage and seed under variable climatic conditions, particularly where growing season rainfall is significantly below average, compared to subterranean clover in recent years in NSW.

Figure 1. Bladder clover showing leaflets and flower heads on top (Photo: Belinda Hackney, NSW DPI) and bladder clover seeds on bottom (Photo: Department of Agriculture and Food, Western Australia)

Similar species

Bladder clover is similar in appearance to many common clover species. Its leaves and flowerheads are similar to arrowleaf clover (*T. vesiculosum*). However, arrowleaf clover grows much taller (up to one metre in height in good growing conditions) and flowerheads of arrowleaf clover are longer. Rose clover (*T. hirtum*) is similar in appearance to bladder clover, but rose clover has very hairy leaves and flowers are a darker pink. Some naturalised clovers such as cluster clover (*T. glomeratum*) also appear very similar to bladder clover.

Figure 2. Bladder clover, arrowleaf clover, rose clover and cluster clover (left to right). (Photos: Belinda Hackney, NSW DPI. Cluster clover photo courtesy of Steve Hughes, South Australian Research and Development Institute)

Plant parts (leaves and flower heads) of cluster clover are generally much smaller than bladder clover and cluster clover flowers are more ball-like (Figure 2).

Area of adaptation

Climatic requirements

In its native environment of the Mediterranean climatic zones of Eurasia, bladder clover grows in soils ranging in texture from sandy loam to clay with pH ranging from moderately acidic to moderately alkaline. Larger collections of bladder clover strains from the Greek Islands have been made in recent years and it has been found growing in areas with altitude ranging from 0-500m above sea level with an average rainfall of 350-800mm.

In NSW, bladder clover has been successfully grown in areas with a long-term average annual rainfall of 400-650mm. However, in recent years, the actual rainfall received in these areas has been as low as 200mm per annum with growing season rainfall as low as 125mm. Understandably, herbage production and seed set in these very low years was reduced. Subterranean clover, however, in these significantly lower than average rainfall years, failed to produce feed of any consequence and died before setting seed.

Soil requirements

In NSW, bladder clover has been grown in soils with pH ranging from 4.8-6.0. In its native range, it grows in soils with pH of up to 8. It is expected that bladder clover will grow successfully in NSW soils with pH range of 4.8-8.0. Bladder clover is not well adapted to soils prone to waterlogging or saline soils and it should not be sown in these situations.

Bladder clover varieties

AGWEST Bartolo is the only variety of bladder clover currently available in the world. It is an early to mid season flowering clover producing flowers approximately 105 days after sowing in Perth. This makes it similar in maturity time to Dalkeith subterranean clover.

Bladder clover in Australian agriculture

How does bladder clover compare to traditional legumes

Bladder clover has performed very well in comparison to traditional legumes such as subterranean clover in research and on-farm trials in NSW in recent years, particularly under adverse seasonal conditions.

Productivity

In the recent drought years, bladder clover frequently produced 2.5 to 3 times more herbage compared to subterranean clover across a range of soil and climatic zones. Importantly, bladder clover was able in these drier than average years, to set adequate quantities of seed for regeneration in the following year, whereas the quantity of seed set by subterranean clover was less than 150kg/ha, a level necessary for strong regeneration in subsequent years at two of the three sites (Figure 3).

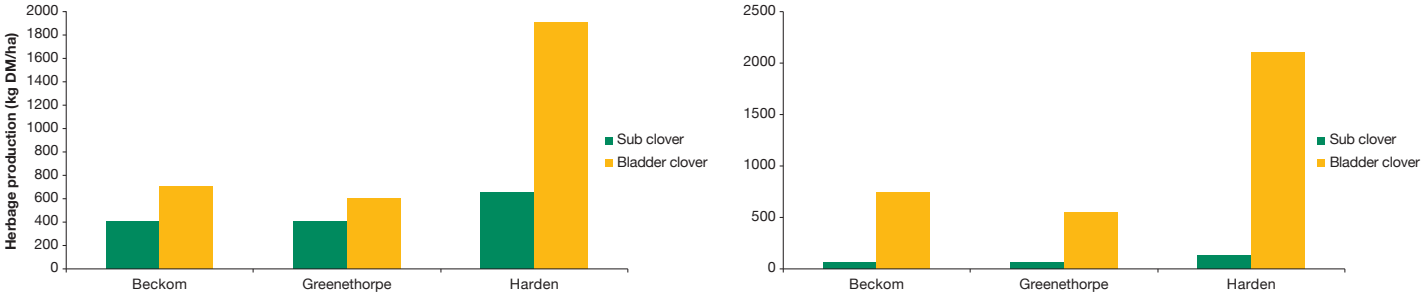

Figure 3. Herbage (kg DM/ha) and seed (kg/ha) production of subterranean clover and bladder clover at three locations in NSW in 2009 – a well below average rainfall year at all locations. (Note: Dalkeith sub clover was sown at Beckom while Seaton Park was used at Greenethorpe and Harden).

In years where rainfall was near average, bladder clover was either more productive or equally productive compared to subterranean clover depending on site (Figure 4). The ability of bladder clover to be productive and be capable of setting seed in a range of environments under differing climatic conditions is potentially of very high value in farming systems.

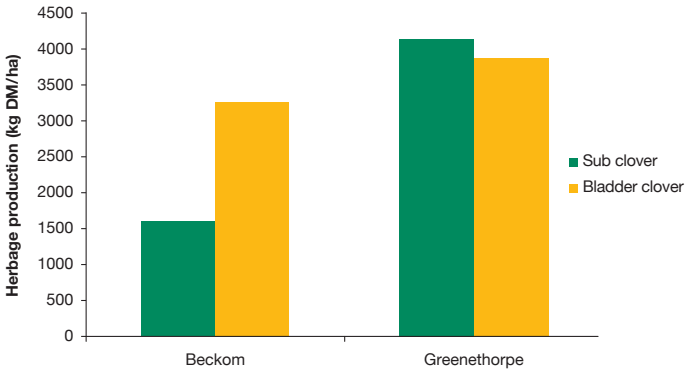

Figure 4. Herbage production of subterranean clover and bladder clover at Beckom and Greenethorpe in 2010 – a higher than average rainfall year at both sites. (Note: Dalkeith sub clover was sown at Beckom while Seaton Park was used at Greenethorpe).

Nutritional characteristics

Nutritionally, bladder clover compares well in terms of digestibility and metabolisable energy (ME) to subterranean clover. Sequential measurements through spring have shown that digestibility of bladder clover and subterranean clover are similar early in spring, but bladder clover maintained higher digestibility than subterranean clover in mid and late spring (Figure 5). Metabolisable energy was similar in the two species throughout the measurement period while the crude protein levels of subterranean clover was generally higher through the early to mid spring period with little difference in late spring (Figure 5).

Predicted weight gain in cattle from GrazFeed indicated higher per head liveweight gain from subterranean clover in early spring (difference of 200 g/hd/d), no difference in mid spring and slightly higher late spring (100g/hd/d) weight gain on bladder clover compared to subterranean clover. Absolute achievable liveweight gain will of course depend on herbage yield in combination with nutrient quality.

Bladder clover appears to have similar palatability to livestock as does subterranean clover. While the flowerheads of bladder clover appear prickly, sheep and cattle readily eat them. Flower heads cause no vegetable matter problems in wool.

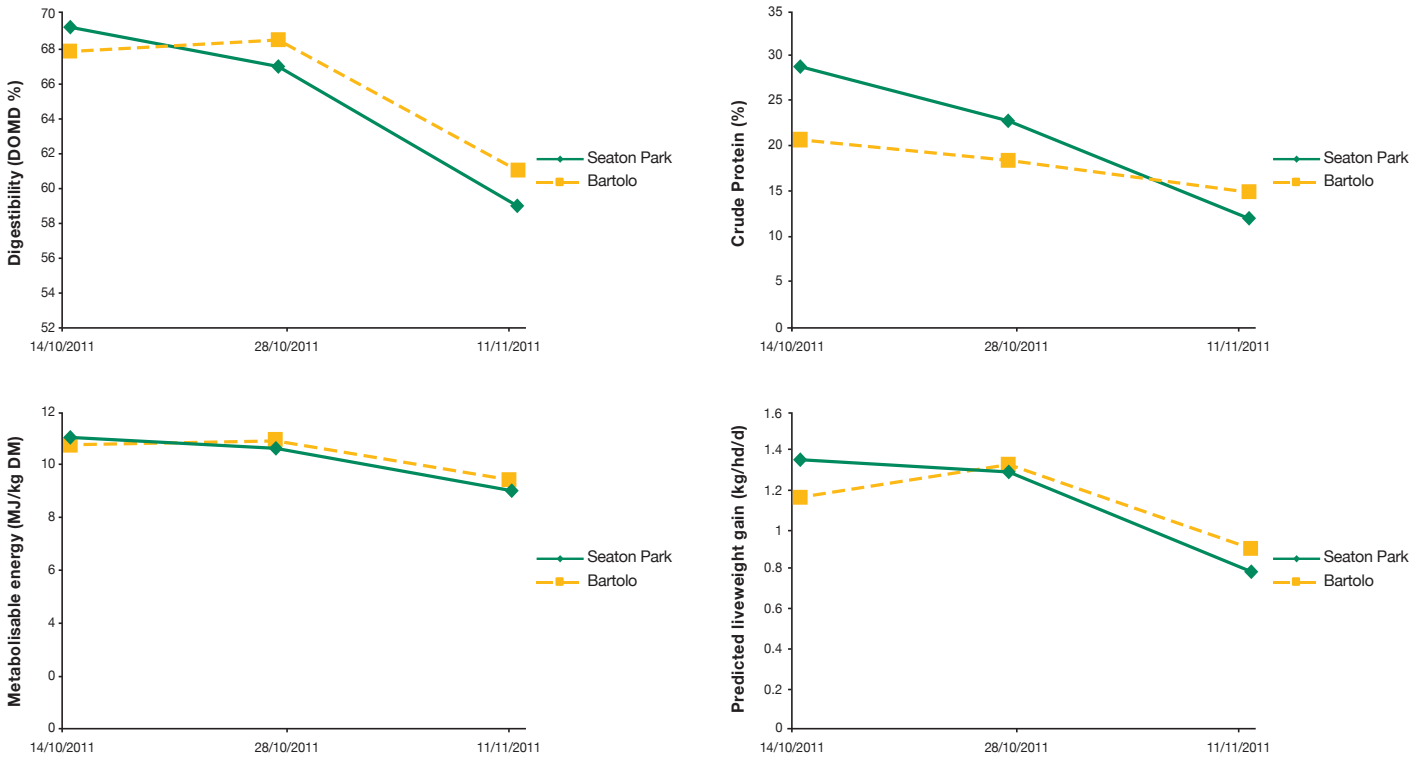

Figure 5. The digestibility, crude protein, metabolisable energy and predicted liveweight gain in weaner cattle from Seaton Park subterranean clover or Bartolo bladder clover at three times in spring. Liveweight gain predictions generated in GrazFeed.

Agronomic characteristics

Hardseededness

In comparison to subterranean clover, bladder clover has high levels of hard seed. Immediately following seed set and senescence the hard seed content of AGWEST Bartolo bladder clover is 97%. If seed is left in the paddock, this reduces to about 56% by May of the following autumn under Western Australian conditions. In comparison, Dalkeith subterranean clover had a post-harvest hard seed content of 88% which had declined to 14% by May. Because of its higher hard seed content compared to subterranean clover, bladder clover is less susceptible to germination under autumn false break conditions (late summer-early autumn rain which causes germination of lower hard seed species resulting in seedling death if no follow up rain is received). Lower susceptibility to false break and higher seed set mean that year to year regeneration of bladder clover may be superior to subterranean clover.

Using bladder clover in farming systems

Which variety should I use?

AGWEST Bartolo is the only variety of bladder clover commercially available in Australian and world agriculture. Further seed collection tours covering areas of the Mediterranean have occurred in recent years which has added to the genetic material of bladder clover in storage in Australia. It is hoped that additional varieties of bladder clover of varying maturity time and hardseededness will be developed from this material in the future.

Using bladder clover in crop-pasture rotations

Recent on-farm research and extension trials in NSW have shown that bladder clover has significant potential for use in crop-pasture rotations in southern Australia. High hard seed levels in bladder clover mean that once a seed bank is established, it can withstand a short cropping phase and regenerate without the need for resowing. Such a pasture-crop-pasture-crop rotation (1:1 rotation) is more flexible than traditional phase farming systems where pasture phases may be 3-5 years in length, followed by a cropping phase of similar length. The 1:1 rotation system allows farmers to utilise nitrogen fixed by bladder clover in their following crops. During the pasture year, bladder clover provides high quality pasture that can be utilised by livestock. Bladder clover has similar hard seed characteristics to French serradella and they are suitable for use as companion species in pasture-crop rotations. There are several ways to establish such a pasture-crop rotation system. These include:

1. Sow a stand alone pasture in the first year using scarified seed – this is a traditional method of pasture establishment a low competition environment for growth and seed set of the pasture.

2. Undersow scarified seed with a reduced rate of cereal in the final year of the cropping phase – undersowing (also known as cover cropping) has been the main method of pasture establishment used in NSW. A survey by the authors in 2009 found that 80% of 200 farmers surveyed used undersowing as their main means of pasture establishment. However, only 30% of farmers felt this method of pasture establishment was highly successful. Problems with undersowing occur due to competition for light and moisture between the cereal and undersown pasture. In trials in NSW in recent years, it has been shown that seed set is reduced significantly where annual legumes are undersown compared to where they are sown alone. Bladder clover however, has proved to still produce high quantities of seed when undersown whereas other species such as subterranean clover produced well below the suggested rate of seed required for strong pasture regeneration in the subsequent year.

3. Twin sowing unscarified seed with normal rate cereal crops – bladder clover when harvested and stored has very high levels of hardseed. The seed coat of bladder clover is much thicker than subterranean clover. When sown in an unscarified form, it takes bladder clover seed much longer to break down than traditional species such as subterranean clover. There is very little germination of unscarified bladder clover seed in the year of sowing. This characteristic can be exploited as an alternative way to establish a pasture. Unscarified seed of bladder clover can be sown with a normal rate of cereal in a one pass operation. Very little of the bladder clover will germinate in the first year and essentially it is just another cropping year. Seed of bladder clover will soften during the crop year and emerge in the following year. This type of system reduces the competition for light and moisture that occurs with traditional undersowing. Twin sowing requires sowing of higher rates of seed of legume – up to 10kg/ha. Farmers need to be harvesting their own seed on farm for this system to be economical.

Recent research in NSW has shown that bladder clover is an extremely robust plant with outstanding ability to produce seed. In experiments at Beckom and Greenethorpe in southern and central NSW (Figure 6), bladder clover produced significantly more seed than subterranean clover, either where it was sown as a stand alone crop or in a cover crop system. At both of these sites, subterranean clover seed production was below the 150kg/ha threshold level considered necessary for strong year in-year out subterranean clover regeneration. Seed set of subterranean clover was particularly affected by cover cropping. Interestingly, bladder clover seed size was generally less affected by cover cropping in comparison to subterranean clover (Figure 6).

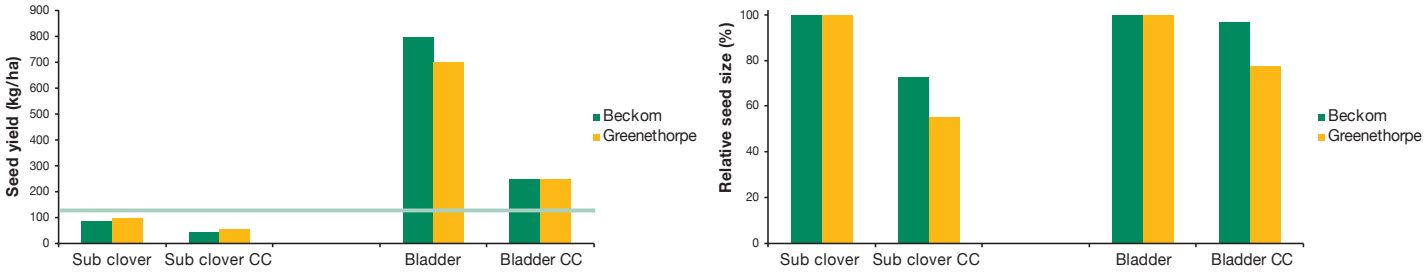

Figure 6. Seed yield (kg/ha) and relative seed size (%) of subterranean clover and bladder clover sown at Beckom and Greenethorpe in NSW either as stand alone sowing or sown under a cover crop. (Note: Dalkeith sub clover was sown at Beckom while Seaton Park was used at Greenethorpe).

The type of establishment technique also has the capacity to affect herbage production in subsequent years (Figure 7). For most species shown in Figure 7, cover cropping significantly reduced herbage production of the legumes in the following winter period. This is because cover cropping places the establishing pasture in direct competition with the cover cereal crop. By contrast, establishment via twin sowing resulted in significantly higher following year legume herbage production for biserrula and French serradella compared to the cover cropping treatment. Bladder clover showed no effect on following year herbage production regardless of whether the cover cropping or twin sowing were the establishment method. This again emphasises the competitive ability and toughness of bladder clover.

This experiment also showed the general ability of new hardseeded legume species to survive early germination. All legumes sown in 2009 germinated on late summer-early autumn rain in 2010. The subterranean clover subsequently died due to a warm dry period, the new hardseeded legumes (bladder clover, biserrula and French serradella) were all able to survive and therefore grow rapidly when follow up rain occurred. The importance of ability to survive early germination and therefore capitalise on warm soil temperature conditions for early growth can be seen by comparing the growth of the early germinating regenerating plots with those of the late autumn sown 2010 scarified seed plots (Figure 7).

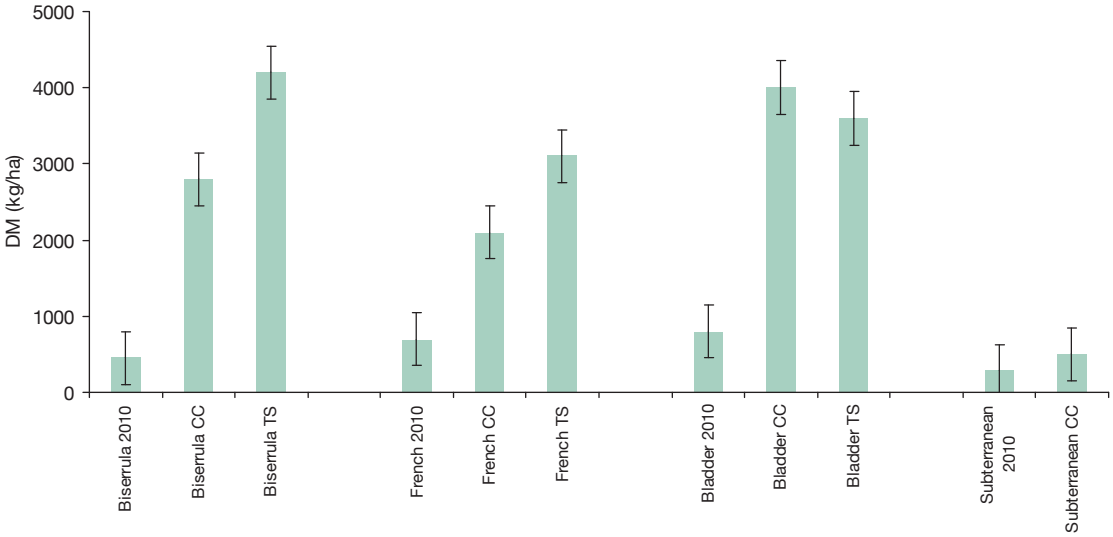

Figure 7. Winter herbage production of biserrula, French serradella, bladder clover and subterranean clover when regenerating from 2009 sowing using either cover cropping (CC) or twin sowing (TS) and compared to late autumn sown scarified seed plots sown in May 2010. Note: There was no twin-sow subterranean clover treatment as it is not possible to obtain unscarified subterranean clover seed commercially.

Research in NSW has also assessed yield and protein levels of wheat following bladder clover compared to the performance of wheat on wheat (Figure 8). Results show that there was no difference in grain protein where wheat was grown after bladder clover with no additional nitrogen fertiliser added compared to wheat produced after wheat where nitrogen was supplied. Similarly, at one location there was no difference in yield, while at the higher rainfall location (Harden) an extra 0.5t/ha of grain was produced after bladder clover compared to wheat on wheat treatment. These results indicate that bladder clover has the capacity to supply sufficient nitrogen to produce the same yield and same quality of cereal without additional nitrogen fertiliser, whereas nitrogen fertiliser is required to maintain wheat productivity in a continuous cropping system. The ability of bladder clover to supply sufficient nitrogen to maintain yields means that farmers can potentially use savings on nitrogen fertiliser for other inputs.

Using bladder clover in longer term pasture systems

Bladder clover can be incorporated successfully into longer term pasture systems with other legume and grass species. As with other annual pasture legumes, bladder clover requires light and soil contact to successfully regenerate year in-year out. To achieve this pastures containing bladder clover and other annual legumes should be grazed in summer and autumn to remove excessive litter burdens. Suitable other annual legume species to sow with bladder clover in a longer term pasture mix include subterranean clover, French serradella, yellow serradella and gland clover.

Benefits of bladder clover in farming systems

Bladder clover in NSW has proved to be a very efficient plant, particularly in drier than average years. The ability of bladder clover to set seed in drier than average years has been exceptional with farmers reporting individual bladder clover plants producing more than 400 seeds/plant in seasons where annual rainfall was 200mm and growing season rainfall 125mm. Dalkeith sub-clover under the same conditions, failed to produce any seed.

The hard seed characteristics of bladder clover lends itself to setting more flexible crop-pasture rotations. Traditionally in NSW, phase crop-pasture systems have been used which is quite inflexible. The hard seed content of bladder clover is well suited to the establishment of 1:1 crop-pasture rotation systems.

Of seed produced in spring by bladder clover, about 55% remains hard, or resistant to germination in the following autumn. Therefore, once a seed bank is established, a farmer may choose to crop over bladder clover in the following year and it will then regenerate in the year after the crop. This type of system effectively utilises the nitrogen fixed by bladder clover in the crop year and can assist in reducing farmers expenditure on inorganic nitrogen sources. This system also allows farmers to utilise high quality pasture in the pasture year for animal production. Bladder clover can be used alone in such a system or can be mixed with other annual legumes such as gland clover and hardseeded French serradella varieties (Margurita and Ercia).

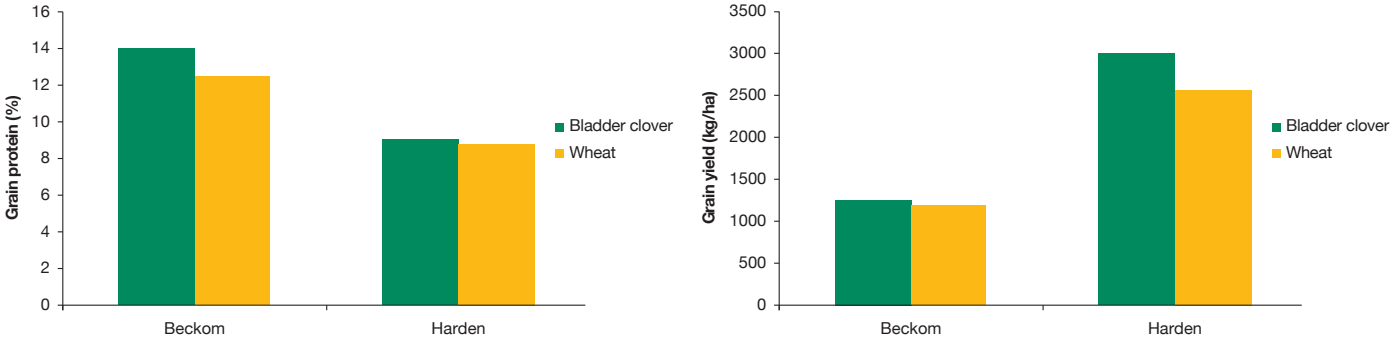

Figure 8. Grain protein (%) and grain yield (kg/ha) of wheat grown after bladder clover with no addition of nitrogen fertiliser compared to wheat grown after wheat where DAP was applied at 120kg/ha at sowing.

Research in NSW has shown that bladder clover is effective at being able to regenerate in a 1:1 crop-pasture rotation system (Figure 9).

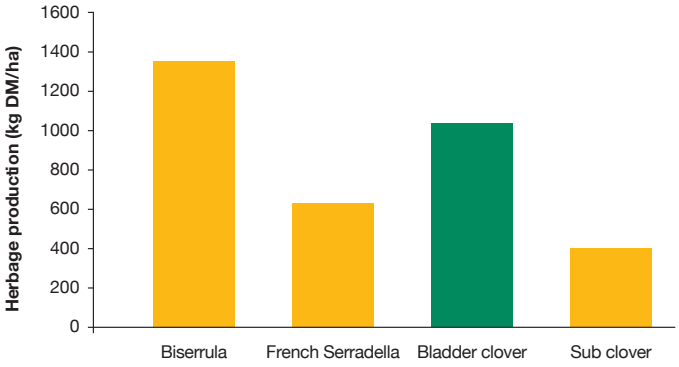

Figure 9. The winter 2011 herbage production (kg DM/ha) of various annual pasture legumes used in a 1:1 crop-pasture rotation system. Legumes were established in 2009 with plots cropped with cereal in 2010. Legumes were then allowed to regenerate in 2011.

Establishing and managing bladder clover

Selecting and preparing the site

As with the establishment of any new pasture, the area to be sown to bladder clover should have been kept as free as possible of weeds for at least three years prior to sowing. This is best done by cropping the site in the years leading up to pasture sowing and keeping it as clean as possible of broadleaf and grass weeds.

Sunfonyl-urea herbicides should be avoided leading up to the sowing of pastures containing legumes and should not be used at all in the 12 months prior to sowing. Residues of sulfonyl-urea herbicides can cause root pruning in legume which results in poor plant thrift due to reduced ability to harvest moisture and nutrients from the soil. Additionally, sulfonyl-urea herbicide residues can adversely affect nodulation as there is less interaction between the reduced plant root mass and soil rhizobia. Soil rhizobia survival is also directly affected by sulfonyl-urea residue. Poor nodulation results in poor nitrogen fixation and therefore reduced availability of nitrogen to the following crop or to other pasture components.

Sowing requirements

Bladder clover is a very small seed and requires only very shallow burial at sowing. Seed should be placed no deeper than 10mm below the soil surface and should only be lightly covered with soil. Bladder clover can be sown either into a conventional seed bed or can be direct drilled. It is not recommended that bladder clover be established in a paddock by surface spreading of seed alone. Some seed-soil contact is necessary for successful establishment. If seed is dropped onto the surface of the soil, then harrows should be dragged over the surface to improve establishment.

Fertiliser requirements

Bladder clover should be sown with fertiliser. At least 10kg P/ha should be applied with seed at sowing and generally a similar quantity of sulphur. Where molybdenum (Mo) deficiency is known, Mo fortified fertiliser should be used at sowing and then every three to five years following. Potassium deficiency can occur on very light sandy soils and this can reduce growth and seed set of legumes. It is always wise to soil test paddocks prior to sowing new pasture. Your local agronomist can assist you in interpreting your soil test results and attending to any nutrient deficiencies.

The importance of inoculation

Bladder clover requires inoculation with Group C (WSM 1325) rhizobium for successful nodulation. The strain of rhizobium in Group C inoculant has been changed over the years. Bladder clover is very specific for the current Group C. Subterranean clover also utilises Group C rhizobium. Subterranean clover will however nodulate with older Group C strains, though significant increases in production have been measured in subterranean clover using WSM 1325 compared to older strains. Bladder clover will sometimes form nodules when inoculated with older strains of Group C inoculant, but these nodules are generally not functional. Therefore do not assume that because subterranean clover has been grown in a paddock that there is no need to inoculate seed. Always inoculate legume seed when sowing.

Inoculant comes in several different forms. These are:

Traditionally, peat-based slurry inoculums have been used. This type of inoculant delivers very high numbers of rhizobium to the seed. Seed must be treated just prior to sowing using this technique and moisture levels in the soil need to be adequate for immediate germination to ensure that effective nodulation occurs.

Rhizobium are also incorporated into pre-coated seed. Pre-coated seed is convenient to use. However, farmers need to ensure that pre-coated seed they purchase is fresh as the rhizobium number in pre-coated seed declines with time. If seed has been coated for more than 4 weeks (Ballard et al. In preparation), the number of viable rhizobium can be very low and therefore nodulation will be reduced. It should also be remembered that coated seed has a lower number of seeds per kilogram compared to uncoated seed. Therefore, sowing rates will need to be increased to compensate for this.

In recent years, long life inoculants have been developed. These inoculants come in different forms depending on the company manufacturing them. They are sown through sowing equipment at sowing time. They can offer greater flexibility in sowing compared to traditional peat-based slurry inoculants as high moisture levels at sowing are not required when using these inoculants.

The main objective with whatever inoculant form is used, is to achieve a high level of nodulation. The production penalty for inadequate nodulation in terms of reduced herbage production and reduced nitrogen fixation can be severe (Figure 10).

Controlling weeds

As with the sowing of any new pasture, it is essential that weed burdens are reduced as much as possible prior to sowing new pasture to give maximum opportunity for successful establishment. In higher rainfall areas, delay sowing until a knockdown herbicide can be applied in autumn to control weeds. In lower rainfall areas, sow bladder clover as close to the autumn break as possible.

In regenerating years, moderate grazing six to eight weeks after germination can assist in controlling weeds and encourage a prostrate sward.

No herbicides are registered specifically for use on bladder clover. However, some broadleaf weed herbicides registered for use in pasture situations have been used to control broadleaf weeds in pastures containing bladder clover. Selective grass herbicides can be used to remove grass weeds from bladder clover. Some farmers in NSW and WA have been using blanket wipers successfully to control weeds in bladder clover pastures (Figure 11). Blanket wipers allow differences in height of bladder clover and target weeds to be exploited to control weeds.

Figure 10. Bladder clover sown at Uranquinty in 2009. Photo on left shows pasture where effective nodulation with group C (WSM 1325) with feed on offer of 2.8 t DM/ha. Photo on right shows bladder clover where there has been complete lack of nodulation due to poor rhizobia quality. Herbage on offer on the non-nodulated pasture was 700kg DM/ha.

Figure 11. A blanket wiper developed for assistance in controlling weeds in herbicide sensitive crops. The wiper utilises differences in height between the pest weed and the crop.

Controlling pests and disease

Red-legged earth mite can cause significant damage to bladder clover, particularly in the first three weeks after sowing. Bladder clover is also susceptible to damage from heavy infestations of blue-green aphids, cow pea aphids and lucerne flea. Monitor pest pressure and control if necessary. Control is particularly important in the year of establishment.

There has been no incidence of clover scorch on bladder clover reported in NSW. Occasional infections of pseudopeziza leafspot have been reported in high rainfall areas of Western Australia.

Management for regeneration

In the year of establishment, it is critical that bladder clover is only grazed lightly if at all. This allows maximum seed set. It is important if some light grazing does occur in the establishment year that livestock are removed just prior to flowering. This allows plants to set the maximum number of seed pods.

Once bladder clover has set seed in the year of establishment, livestock can be reintroduced. It is important to graze the stand at this stage to remove excessive quantities of plant material and litter and encourage regeneration.

Once a bladder clover stand is established it will tolerate moderate to high grazing pressure well. Grazing through winter encourages prostrate growth.

Seed production and harvest

Bladder clover is an aerial seeder as opposed to subterranean clover which buries a high proportion of burrs. Bladder clover seed is easily harvested using a conventional cereal header and this has been done successfully by NSW and WA farmers. Highest seed recovery is achieved using an open-front header with a tined reel and crop lifters. Drum settings should be similar to those used for wheat, but with a reduced wind speed. In very short seed crops, bladder clover may be raked into windrows prior to harvesting.

It should be remembered that the seed coat of bladder clover is much thicker than that of subterranean clover. Aggressive scarification is needed achieve high germination percentages. There is no restriction on harvesting of seed of AGWEST Bartolo bladder clover for personal use. Only licensees can market bladder clover seed.

Bladder clover and animal production

How does animal production from bladder clover compare to other legumes?

As yet in NSW, the area sown to bladder clover is quite small and actual livestock production figures on bladder clover pasture is limited. Feed test results show bladder clover to have similar digestibility, metabolisable energy and protein levels to subterranean clover.

Modelling of animal production figures using Grazfeed show that animal production achievable from bladder clover on a per head basis is similar to subterranean clover (see Figure 5). However, herbage production of bladder clover at this site was higher than subterranean clover in early and mid spring and therefore the potential animal liveweight gain achievable per hectare is higher at these times than for subterranean clover (Figure 12).

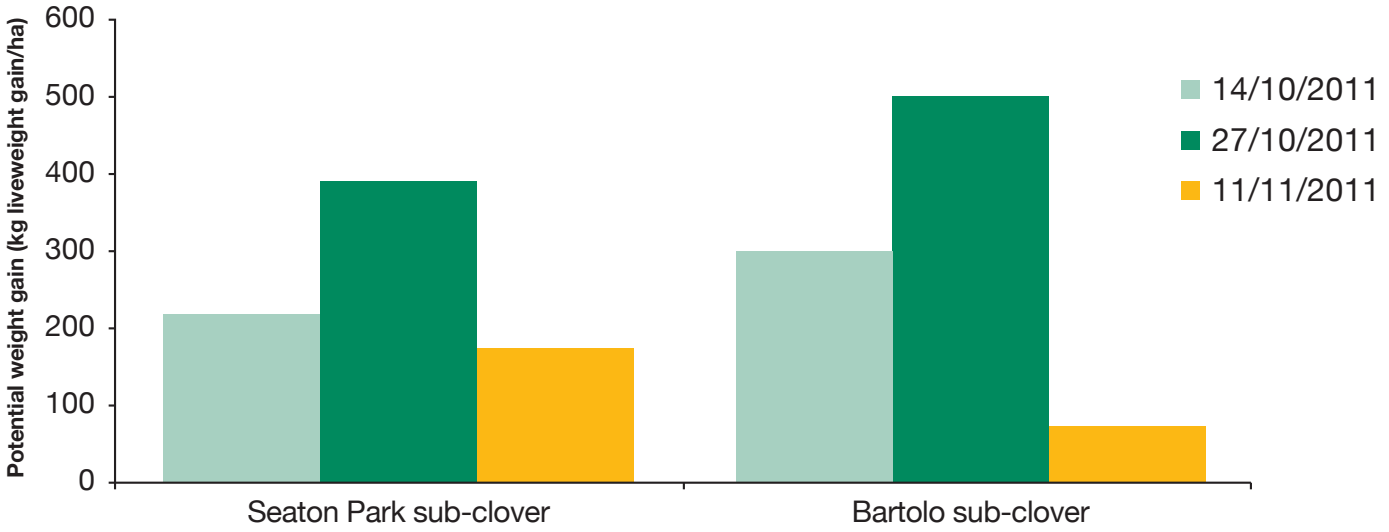

Figure 12. Potential liveweight gain achievable per hectare of forage sown at three times in spring on Seaton Park subterranean clover and Bartolo bladder clover as calculated from GrazFeed.

It is also worth noting that numerous experiments shown in this document have shown significantly higher herbage production of bladder clover compared to subterranean clover in both below and above average rainfall years. Should the quality of herbage be comparable to subterranean clover, then it would be possible to achieve significantly more absolute animal production from bladder clover pasture than from subterranean clover pastures.

How can the agronomic characteristics of bladder clover be used to increase animal production?
(ie higher herbage production in lower rainfall years)
Bladder clover in NSW trials has consistently produced higher herbage masses than subterranean clover. Inclusion of bladder clover in pasture-crop rotations or in long-term pasture mixtures has the potential to significantly increase feed supply in lower than average rainfall years. This may allow farmers to retain more stock and/or achieve higher weight gains in such years than on traditional annual legume based pastures. Additionally, the seed set of bladder clover in lower than average rainfall years has been significantly higher than for subterranean clover. This results in greater surety of year to year production than subterranean clover. In near average, average and above average rainfall years, herbage production of bladder clover is similar to subterranean clover.

Bladder clover has very low levels of phyto-oestrogens formononetin and gensiten. The levels of these compounds are well below the levels where infertility and difficult births may be expected in livestock.

Farmer experience with bladder clover

Farmer name: Mike and Velia O'Hare
Location: Beckom, NSW
Long term average rainfall: 400mm
Farming enterprises: Winter crops and sheep
Variety sown: AGWEST Bartolo

Reasons for move to new legumes: Sub clover had really disappeared from the pasture and crop paddocks over time due to drought, false breaks and short springs. Sub clover is a great plant, but in tough conditions, it struggles to set seed, produce useful amounts of feed and add nitrogen for crops. Getting sub clover back into the system in a widespread way would be just too expensive and it doesn't overcome the problems it has in poor years. Species that could perform in a range of seasons reliably were needed. From information from NSW DPI and Department of Agriculture WA trials, it looked as though bladder clover would have some potential.

Bladder clover was first sown on the property in 2009 which was a really poor year with the growing season only about 50% of the long-term average. The bladder clover plants didn't get any bigger than about 7-10 cm in diameter (Figure 13), but on average, there were 400 seeds/plant, which was amazing considering the year. In the following autumn the regeneration was very good and seed was harvested off the seed block in spring 2010.

Why bladder clover?: It is incredibly tough and has tremendous ability to produce seed, even in tough conditions. It is also very easy to harvest. It has a lot of potential for crop-pasture rotations in association with other annual legumes with similar hard seed characteristics.

Any problems?: Bladder clover really needs well drained soils. If it is on the right soil type, it does well.

How do you plan to use bladder clover in the future?: Continued use in crop-pasture 1:1 type rotations, probably in combination with gland clover and possibly with some serradella.

Figure 13. Bladder clover sown at Beckom in 2009. Photo on top left shows individual plant size in October 2009. Photo on top right shows bladder clover stand in the foreground in 2009. Rainfall in the growing season for 2009 was 50% of average. Individual bladder clover plants even in these poor growing conditions produced an average of 400 seeds/plant.

Figure 14. The same paddock of bladder clover in spring 2010 at Beckom which regenerated from the 2009 sowing.

Farmer name: Ian Westcott
Location: Peak Hill, NSW
Long term average rainfall: 450mm
Farming enterprises: Winter crops and sheep
Variety sown: AGWEST Bartolo

Reasons for move to new legumes: Sub clover and medics were the main legumes in pastures on the farm. The tough drought years and dry finishes often encountered in spring which affected seed set along with summer storms that caused germination (false breaks) really depleted the seed bank to a point where these legumes were just unreliable. Tough legumes that produced a lot of seed and feed in all seasons were needed. The fact that new legumes could be header harvested also meant that legumes could be produced on farm and reintroduced to large areas of it at relatively low cost.

Why bladder clover?: NSW DPI put the first trials on the farm in 2008. Bladder clover was the outstanding species in that trial. Information from the department in WA also showed strong potential of bladder clover.

Any problems?: There is less herbicide choice with bladder clover compared to sub clover, but with good paddock planning you can get around it. Also, producing seed on farm means sowing rates can be higher which provides greater weed competition.

How do you plan to use bladder clover in the future?: Will continue to use it in crop-pasture rotations and also in areas of the farm where longer term pastures are better suited.

Figure 15. Ian Westcott in a seed crop of bladder clover at his Peak Hill property in spring 2010. This paddock went on to produce 700kg seed/ha.

Farmer name: Julie and David Brien
Location: Greenethorpe, NSW
Long term average rainfall: 600mm
Farming enterprises: Winter crops and self-replacing meat sheep
Variety sown: AGWEST Bartolo

Reasons for move to new legumes: Julie and David's father used to produce sub clover seed and sub clover has been the basis of long term pastures and pastures in the crop rotation. Sub clover had declined due to poor seasons – it is good in good seasons, but unreliable in poorer ones. Needed legumes that would be more flexible in the crop rotation and offer alternatives to other crops such as lupins. Something that could cope with tough seasons and would provide high quality feed for animal production as well as nitrogen for crops was needed, ability to header harvest seed was an extra benefit.

Why bladder clover?: Its characteristics seemed to suit the type of climate, soils, animal production systems and crop rotations on the farm. In addition, it was a strong seed produced and seed was easy to harvest.

Any problems?: No

How do you plan to use bladder clover in the future?: Continued use in crop-pasture rotations and longer term pastures. Will probably be used in mixtures mainly.

Figure 16. Left: Julie and David Brien, Greenthorpe, NSW in a bladder clover paddock in early spring. Right: The paddock later in the season in full flower. The paddock produced 1.2 t seed/ha.

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