MARLBOROUGH RESEARCH CENTRE TRUST

PASTORAL

Project Title: Adapting to change with legumes in summer dry Marlborough Hill Country.

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Objective(s)

1. Increase lamb weaning weights achieved through enhanced farmer knowledge and adoption of alternative species and grazing management strategies to optimise legume production and minimise annual grass weeds; geographically based legume map highlighting appropriate areas for different legume species.
2. To encourage greater economic responses to other wise depressed Marlborough pastoral environment through demonstration and the use of new pasture species in this environment.
3. To encourage establishment of all year round forage species that will provide and add value to a difficult farming environment. Shift present dry matter values for hill country from 3000 kg DM/ha to 6500 kg DM/ha.
4. Provide an opportunity to establish plant species into non-productive difficult drought-prone soils eroded soils.

Brief History of Project: The impact imposed on pastoral farmers through the lost of prime pastoral farm land (23,921 ha –MDC Viticulture Mapping History 2010) to growing of grapes, has forced pastoral farmers to make use of summer-dry, soil erosion prone and danthonia dominated hill country environment. Land management issues linked with farm profitability and environmental impacts are significant. This tends to exploit farmer's attitudes and behaviours, in particular focusing on understanding barriers to the up-take of information and knowledge. This includes research outputs, into everyday integrated farm management practice.

Under Marlborough conditions, buried seed populations will identify and determine future clover production responses. Marlborough has conditions ideal for early annual clover varieties, providing increased quality production before the onset of summer dry conditions.

Weld Pass site. A small plot site established in autumn 2007 includes a range of annual clovers *Trifolium subterranean* cv Dalkeith, Leura, Woogenellup and Goldburn, *Trifolium michelianum Sav syn balansae* cv Bolta, *Trifolium fragiferum* cv Onward, *Trifolium repens* cv Nomad. This site has been grazed to simulate set stocking to identify annual clover variety persistence. Ongoing persistence through annual re-establishment has decline rapidly with plant populations less than 5% at this period (2010).

Grigg property. As ewe numbers have decline cattle numbers have increased from 100 to 220, in valuable in their use in pasture quality control late spring into summer dry conditions when pasture quality feed values deteriorate. Annual clover cultivars (cv) sown were, Woogenellup (5 kg/ha), Leura (3kg), Dalkeith (2kg), Tonic (plantain) (500gm) and Balansa clover (2.5kg). In the first year of establishment (06) results show that measurements to identify establishment populations of sub clover where relative; OS treatment on the north face being slightly higher than the south face, while DD was slightly higher on the south face. Strategic use of stock within season growth of annual clovers has ensured plant population, re-establishment remaining constant.

Gorman property. This site was measured to identify composite values, clover, grass, weed and bare site content, over that period from 2006 to 2009. Previous results showed as the plots mature over that time there was a significant decline in sub-clover responses on the drier north face sites than the wetter south face. Measurement from these sites will be come a project titled “adapting to climate change with legumes for summer dry Marlborough hill country pastures”. This site was not remeasured over this period, due to unsuccessful bid for SSF MAF funds (2009).

Avery property. A small plot site was established autumn 2008, a range of annual clovers were directed drilled these included *Trifolium subterranean* cv Denmark, Mt Barker, Woogenellup and Dalkeith. Results. Results show clover composites for Mt Barker 71%, Bolta 57%, Denmark 42%, Arrotas 39% Hamua 38%, Woogenellup 27%, Dalkeith 8%, Prima 5% and Onward 0%.

Dawkins property. *Trifolium vesiculosum* cv Arrotas, was sown. Maximising subterranean clover and other annual clovers in Marlborough’s hill country is the key to weaning 80% of sale lambs prime.

Results from these established annual clover sites project has confirmed; that to continue to demonstrate ‘best practice’ clover establishment, management and animal grazing systems, needs to ensure that the processes of annual legume seed strike to ensure and ecological their agronomic values are successful: from autumn - flowering in spring – to seed set in summer.

Results from previous these sites has also demonstrated that annual clovers are able to compete within Danthonia dominant grasslands, provided adequate post establishment herbicide and fallow processes are followed. Increased nitrogen produced from clover fixation is identified as having a value of $9.56/kg nitrogen (fig. 2009) produced. The greater the dry matter response in clover, the greater the nitrogen fixation response.

Increased clover production will aid lactating ewe, increasing lamb production, this has been clearly demonstrated on Tempello, and there is a need now to extent that technology to further

hill country dry-land sites. Subterranean clover is an annual clover commonly sown in the autumn. Buried seed populations will identify and determine future clover production responses. Seasonal impacts brought about by climatic variations and management practices are keys to annual clover sustainability and success.

Methodology

Sites that were investigated this period included Grigg, Lissaman and Dawkins properties (failure to gain sufficient funds, sites Gorman, Turnbull, Kemp and Avery retained at maintenance).

Sites laid down Grigg (aut 2008), Lissaman and Dawkin (aut. 2009). Measurements were made to investigate establishment success. Those impacts are to demonstrate various farm management and animal grazing systems. This will identify the processes of annual legume seed strike and their agronomic values are successful, especially from autumn establishments i.e. flowering in spring and seed set through summer.

Measurements will included, dry matter production (%), plant density, flowering prevalence in response to sowing rates, soil fertility, north south aspects, they will determined in Spring and July of each year. Pasture covers at the later period will determine nitrogen requirements and applications and what affects that may have on annual clover response.

Buried seed populations will identify and determine future clover production responses.

Using various animal classes will assist in identifying; best grazing management treatments. With a linkage to identifying clover reseeding abilities under a range of grazing management intensities, durations and frequencies.

Measurements will also include seedling populations, mature herbage yield and seed production. A site will also be setup to investigation the viability of seed recovery for future new site clover species sowing and establishment.

All three sites were treatment with herbicide Glysophate (4 ltrs/ha) September 2009 and then again February 2010 pre-sowing of annual clovers. Then grazed 20 SU/ha to reduce any dry pasture residue. Clover selection for each site is identified Graph 1, 2 and 3, sown direct drill 3 March 2010. Plot size 50 m x 5 m replication 2. All sites were fenced to exclude stock. Further herbicide treatments 65gms Preside and 700gms Gallant /ha at clover true-leaf stage (6-8 leaves) on 14/09/09. After data collection November 2010 all sites were grazed (Dawkins Lissaman) hoggets at 20 SU/ha, (Grigg) Weaner cattle 50 SU/ha grazing period 1 day residual covers 500 kg DM/ha.

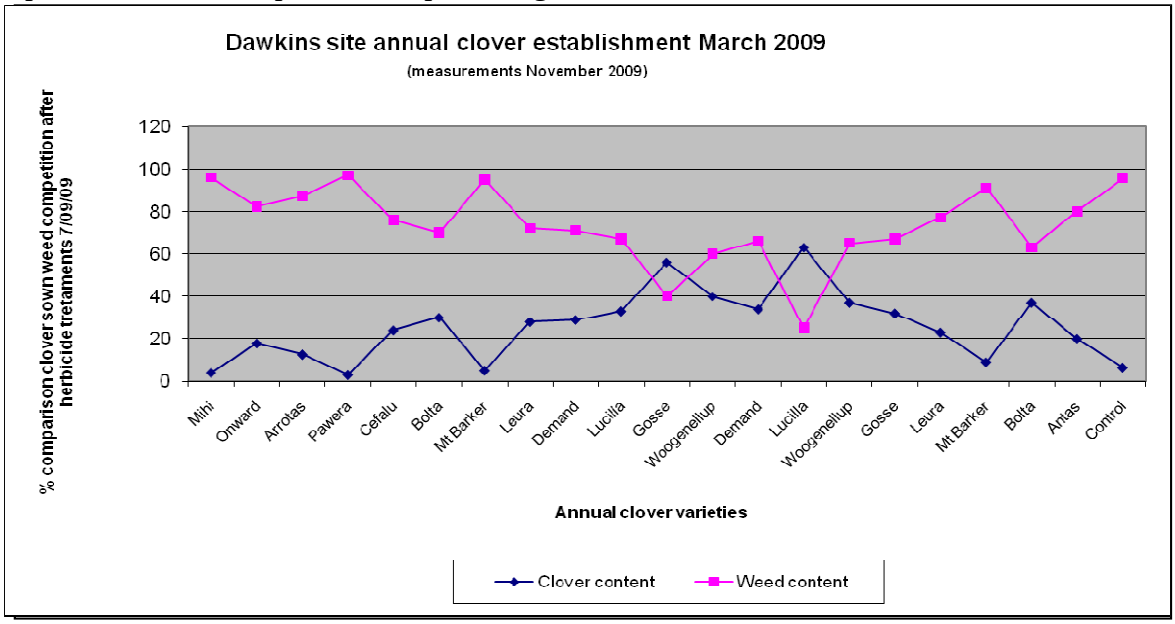
Results to date suggest:

For this period three sites were measured, including Dawkin, Grigg and Lissaman properties. Properties, Turnbull, Gorman, Avery and Kemp are not included. These 4 sites have been retained within the over-all management plan and were maintained at maintenance management only.

Dawkins. Known as the Pyramid, situated on Waihopai Valley Road. Soils are Jordan, silt loam; greywacke alluvium. The site is flat undulating, easy rolling terrace. Site is prone to high soil moisture content due to the site location.

Photo 1. South-north location annual clover plots, infestation Curnow curse.

Graph 1. Dawkins property site, annual clover varieties sown 2009, clover establishment responses v weed composite, as a percentage.



Graph 1, identifies clover establishment responses as a percentage. All clover species sown show poor establishment results with significant clover content variations across the plots (west east) Plan 1. Observations show that all treatments for establishment have been affected by significantly high weed populations; attempts to treat with herbicide and animal grazing made controls difficult, accentuated by wet under-foot conditions leading into spring 2009. The site is also difficult to manage due to clay loam and the area sloping into a hollow which retained high soil moistures for the greater period leading into the “spring flush”. Herbicide treatment has also been identified as difficult to process. It is critical in the matter of timing of applications, clover species flowering dates and the type of treatment or chemical required so as not to hinder plant growth, development. This site was re-sown with same treatments and clover species, 3 March 2010.

Plan 1. Shows clover and weed compositions as a percentage response over sown site.

Plots run south-north, measurements were made across each plot from west-east

	Clover content percentage by site							Weed content percentage by site						
variety	*1*	*2*	*3*	*4*	*5*	*av*	*sd*	*1*	*2*	*3*	*4*	*5*	*av*	*sd*
Mihi	2	0	5	5	8	4	3	98	100	95	95	92	96	3
Onward	4	10	50	15	10	18	18	96	90	50	85	90	82	18
Arrotas	30	15	10	3	5	13	11	70	85	90	97	95	87	11
Pawera	5	5	0	0	5	3	3	95	95	100	100	95	97	3
Cefalu	40	5	5	40	30	24	18	60	95	95	60	70	76	18
Bolta	60	15	5	30	40	30	22	40	85	95	70	60	70	22
Mt Barker	3	2	5	5	10	5	3	97	98	95	95	90	95	3
Leura	25	30	60	10	15	28	20	75	70	40	90	85	72	20
Demand	45	55	10	10	25	29	20	55	45	90	90	75	71	20
Lucilla	15	15	55	35	45	33	18	85	85	45	65	55	67	18
Gosse	75	75	55	45	30	56	19	15	15	45	55	70	40	24
Woogenellup	85	55	15	20	25	40	30	15	45	85	80	75	60	30
Demand	75	15	35	25	20	34	24	25	85	65	75	80	66	24
Lucilla	90	85	55	45	40	63	23	10	15	45	55		25	22
Woogenellup	85	75	15	5	5	37	40	15	25	95	95	95	65	41
Gosse	85	25	20	15	15	32	30	15	75	75	85	85	67	29
Leura	45	20	15	25	10	23	14	55	80	85	75	90	77	14
Mt Barker	20	5	0	5	15	9	8	80	95	100	95	85	91	8
Bolta	85	45	15	25	15	37	29	15	55	85	75	85	63	29
Antas	45	15	15	20	5	20	15	55	85	85	80	95	80	15
Control	2	5	5	5	15	6	5	98	95	95	95	95	96	1

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N
WE
S

0-10
11.-30
31-60
61-70
71-80
81-100

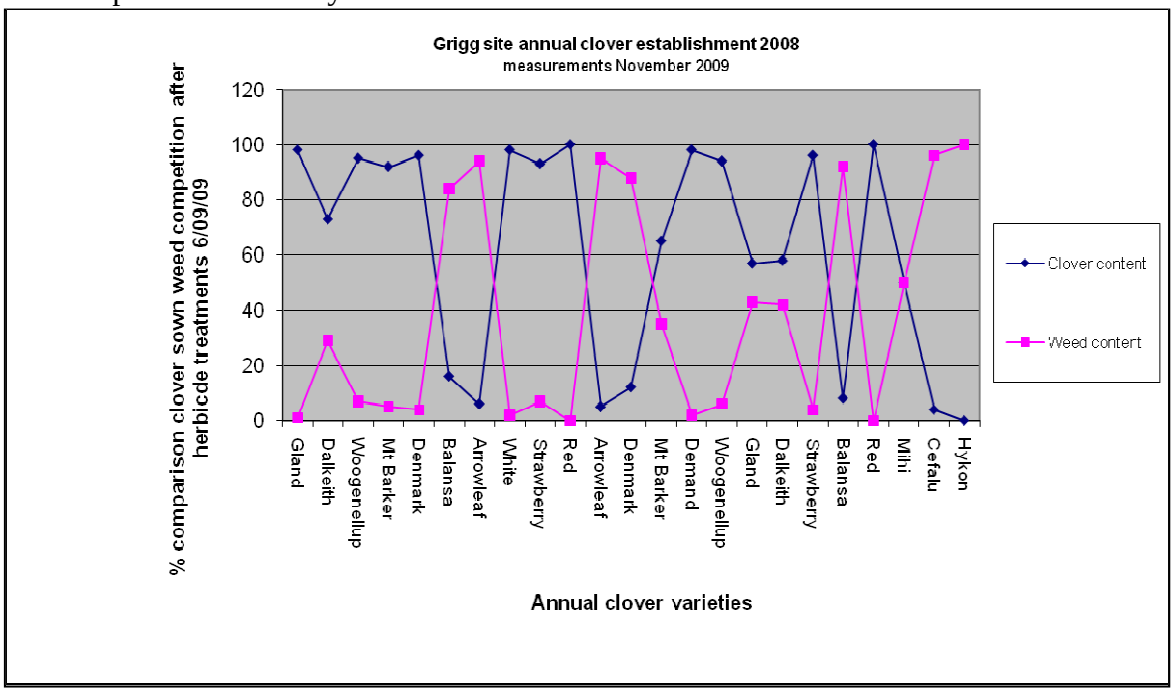
Plan 1 shows annual clover varieties establishment response and weed compositions 140 days after sowing. Measurements were scored as a percentage along a transect each transect was 10 m long replicated 5 times within each annual clover species plot. From each of transect sites where total species (grass, clover and weeds) were collected to identify species compositions. The aim was to show sown species as a percentage response from sowing to measurement at establishment. The period between sowing date and establishment measurement was 140 days. At the same time weed populations as a total percentage was also measured. Weed species identified, (east-side plots) *Poa annua* 30.45%, *Stellaria media* (chickweed) 19.07%, *Veronica agrestia* (speedwell) 5.46%, *Calandrina compressa* (Curnow curse) 11.21% and *Uritica urens* (stinging nettle) identified but collected within areas sampled, (west-side plots), *Poa annua* 42.68%, *Stellaria media* (chickweed) 28.39%, *Veronica agrestia* (speedwell) 7.14%, *Calandrina compressa* (Curnow curse) 14.74% and *Uritica urens* (stinging nettle) identified but not measured in samples collected. There are significant variations between sown species measured east west. This is clearly linked to soil type within contours and site form. The higher the percentage the greater species composite. The western sites tended to contain soils with a higher percentage of clay loam which contained a slope slightly elevated to the area east, The eastern sites tended to hold soil moisture greater than the western sites. As a consequence weed species populations are significantly higher with possible reason for sown clover species percentage reductions.

The total site was sprayed with 65gms Preside and 700gms Gallant /ha at clover true-leaf stage (6-8 leaves) on 14/09/09. This was aimed at reducing identified weed species populations prior to new clover growth. Observations showed that all clover species sown were suppressed after treatment with herbicide. This reflected on the vigour of sown clover species as a percentage at the measurement period. Once measurements were completed the total site was stocked at 20 SU/ha for a day.

Grigg. Site located Tempello, Brancott Road. The site is situated on Wither Hills soil, silt loam greywacke silts tends to dry rapidly over the summer period. The site is located next to a hill slope, which is prone to wet under-foot conditions during winter.

Photo 2. South – north location annual clover plots.

Graph 2: Grigg property shows annual clover species re-establishment, identifying clover and weed compositions after 2 years.



This site was established May 2008 and managed as required to allow best establishment opportunities for annual clovers sown. 12/11/2009 this site was measured to identify annual clover re-establishment response at year two. Measurements include annual clover sown species and weed composite as a percentage. This site was also saturated during the winter period with water seepage from the adjacent hill slope. That observation may also be reflected in the results of the measurements taken at this period i.e. early flowering species verses late flowering species, clover content weed content. This site was also treated (08/09/2009) with the herbicides Gallant and Preside to reduce weed populations, stimulated by raising spring

soil temperatures and “spring-flush”. After measurements were completed; the site was grazed by weaner cattle, until dry matter covers were reduced to 500 kg DM/ha.
Plan 2: Grigg property compares re-established clover species response as a percentage against weed composites.

gate entrance north boundary plots run west - east

	Clover content percentage by site							Weed content percentage by site							
species	1	2	3	4	5	av	sd	1	2	3	4	5	av	sd	
Gland	100	95	100	100	95	98	3	0	0	0	0	5	1	2	
Dalkeith	95	65	55	65	85	73	16	5	45	45	35	15	29	18	
Woogenellup	100	95	85	100	95	95	6	0	15	15	0	5	7	8	^
Mt Barker	95	85	100	85	95	92	7	5	0	0	15	5	5	6	N
Denmark	100	95	95	90	100	96	4	0	5	5	10	0	4	4	WE
Balansa	25	10	10	15	20	16	7	75	90	90	85	80	84	7	S
Arrowleaf	0	15	10	5	0	6	7	100	85	90	95	100	94	7	
White	100	95	95	100	100	98	3	0	5	5	0	0	2	3	
Strawberry	100	85	80	100	100	93	10	0	15	20	0	0	7	10	
Red	100	100	100	100	100	100	0	0	0	0	0	0	0	0	0-10
Arrowleaf	5	15	0	0	5	5	6	95	85	100	100	95	95	6	11.-30
Denmark	25	5	0	15	15	12	10	75	95	100	85	85	88	10	31-60
Mt Barker	45	15	95	85	85	65	34	55	85	5	15	15	35	34	61-70
Demand	100	95	100	100	95	98	3	0	5	0	0	5	2	3	71-80
Woogenellup	100	95	95	85	95	94	5	0	5	5	15	5	6	5	81-100
Gland	5	100	15	100	65	57	45	95	0	85	0	35	43	45	
Dalkeith	75	65	25	100	25	58	33	25	35	75	0	75	42	33	
Strawberry	100	95	100	85	100	96	7	0	5	0	15	0	4	7	
Balansa	5	20	0	0	15	8	9	95	80	100	100	85	92	9	
Red	100	100	100	100	100	100	0	0	0	0	0	0	0	0	
Mihi	15	10	85	75	65	50	35	85	90	15	25	35	50	35	
Cefalu	5	0	0	15	0	4	7	95	100	100	85	100	96	7	
Hykon	0	0	0	0	0	0	0	100	100	100	100	100	100	0	

Dactylis glomerate (Cocksfoot), *Cichorium intybus* (Chicory), *Plantago spp*.(Plantain), *Poa annua*, *Agrostis tenus* (Browntop), *Vulpia dertonensis* (Hairgrass, *Bromus mollis* (Soft brome), *Juncus spp.* (Rushes), *Cirsium lanceolatum* (Scotch thistle), *Stellaria media* (Chickweed), *Veronica agrestia* (Speedwell), *Leotodon autumnalis* (Smooth hawkbit), *Anagallis arvensis* (Scarlett pimpernel), *Sonchus asper var*. (Sour thistle), *Brassica spp.* are weed species identified within the sown species site. Each species identified were identified as a percentage. Plan 2 identifies those variance found within annual clover species sown. The highest percentage of weed composite was found in those annual clover species that are found to be more up-right in growth and early flowering. These species included Red, Strawberry, Demand and Denmark clovers. Clover species that are identified as being more prostrate and mid to late flowering, include Cefalu, Hykon, Balansa and Arrowleaf.

Observations show that soil moisture is greatly influenced by site location and water run-off onto the site, from adjacent hill slopes which run into the site. This may also be the catalyst for higher weed populations in the more prostrate and mid-late flowering clover species.

Lissaman

Site located Breach Oak Richmond Brook Road Seddon. The site is situated on a Hororata soil, silt loam and stony or boundary silt loam sandy in places. The site is a terrace falling north-east., with possible moisture run-off from North West hill slope during winter, soils prone to summer drought.

The property is known as Breach Oak located off Marama Road Seddon

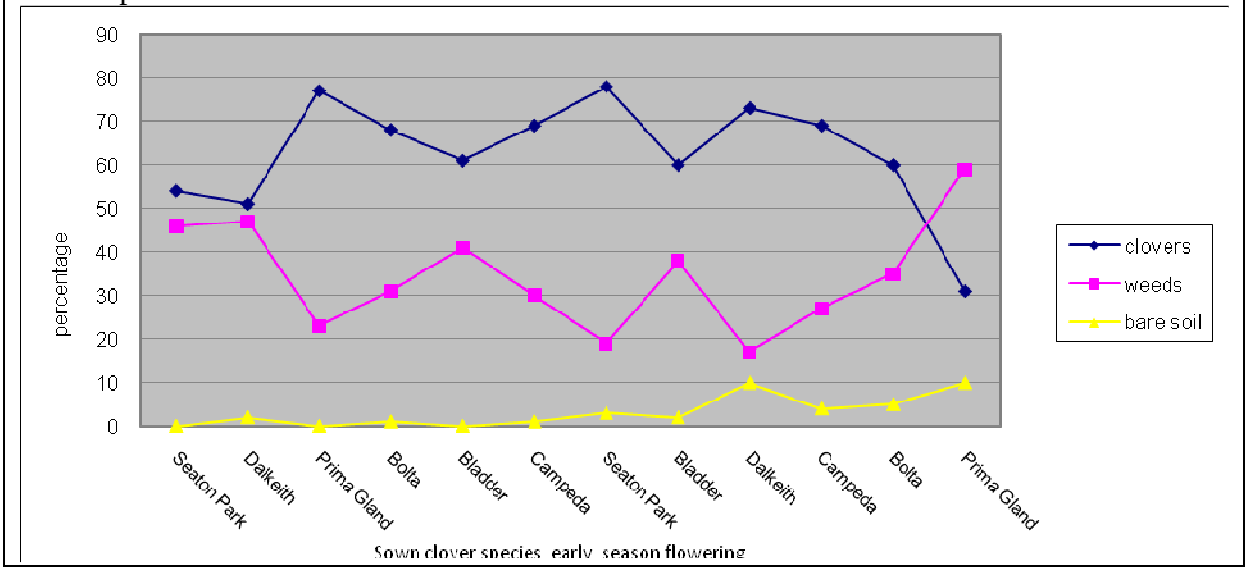
The Lissaman site includes Graphs 3, 4 and 5. Measurements include composites as a percentage of sown annual clovers, weed populations and bare ground. There are three sites on this property and treatments include annual clover species identified as earlier, mid to late and late flowering. Flowerings dates with those statements include early flowering as at mid-September and mid – late flowerings as at those clover species that have a flowering date mid to late October.

We know that the reproductive phase of annual clovers especially subterranean clover, cyclical commences with the initiation of flowering in winter and terminates with the seed production. We are aware the timing of flowering is determined by the amount of cold required to commence flower initiation and then occurs as a response to photoperiod and/or temperatures. We are also aware that there is a wide range in the time of flowering among subterranean clover, hence the reasoning for sowing the range of annual clover species for this site.

Early studies show that early flowering ecotypes require little cold requirement for vernalization and therefore flowering in early spring Graph 3. Mid to late flowering ecotypes need exposure to temperatures below 10^{o} C for 6-10 weeks before initiation occurs, so as not to commence flowering until early summer Graph 4 and 5 identifying those species. The aim is to produce sufficient mature seed before the onset of summer drought Graph 6 identifying those climatic variables over that critical growing period under Marlborough conditions.

As with the Dawkins and Grigg sites this area was also treated with the herbicides Gallant and Preside on 15/09/09

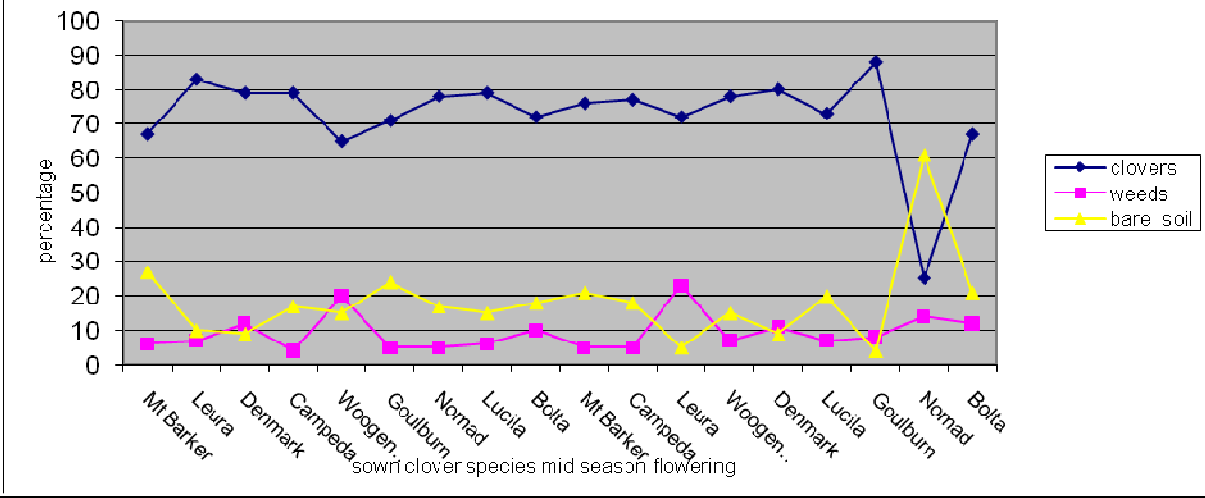
Graph 3: Lissaman property composite measured as a percentage - early flowering annual clover species.



Graph 3 shows that nine of the annual clover species sown were found to be within the 60-80 percentile range as a composite sown, linked with those results weed content measurements ranged within the 20-40 percentile range. The question that remains un-answered, what impact does resident seed populations that are allowed to germinate then complete with the sown species? The second question that also remains un-answered what has Marlborough's climate played on germination of the sown species? We also need to bear in mind the measurement date was at 140 days Early flowering annual clovers from sowing to flowering

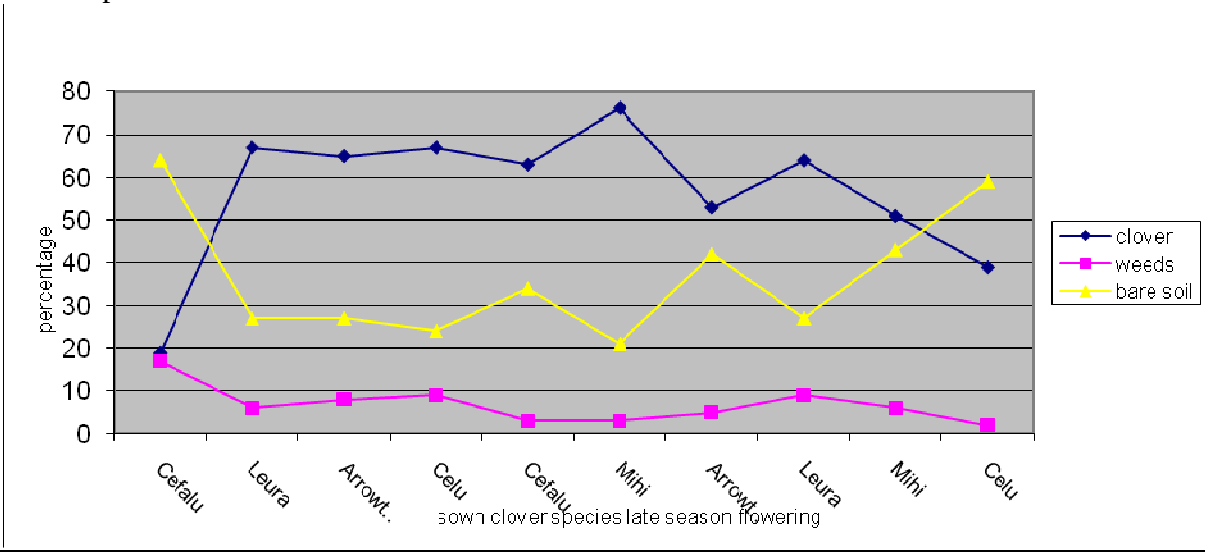
period is 81 to 95 days. The third question that also remains un-answered what would those percentile been if measurements were at 95 days?

Graph 4: Lissaman property composite measured as a percentage - mid-late flowering annual clover species.



Graph 4 shows annual clover species identified within this flowering range are showing a higher percentile range than the earlier flowering range. Results for 14 of the sown species fall within a 70-90 percentile range and the major of those annual clover species have also significantly less weed content. This ranges from 10-20 percentages and 10-20 percent lower, than the earlier flowering annual clover species. The optimal range for mid-late flowering annual clover species is identified as 125 to 135 days.

Graph 5: Lissaman property composite measured as a percentage - late flowering annual clover species.



Graph 5 shows the results from annual clover species that have been identified as early season flowering. 6 of the sown species fall within the 60 to 80 percentile range, linked with that is the treatments also contain significant areas of bare ground (no cover content) and weed populations at less are in less than 10 percent this significantly less than early and mid-late flowering annual clover species. The questions raised what impact did Marlborough's climate

have on germination, did low soil moisture and higher temperatures suppress seed germination and persistence from October to the measuring date in November?

Climate

Information was collected from two sites (1) Marlborough Research Centre Grove Road the other (2) Awatere Molesworth site turn-off Seddon. Results included (1) monthly rainfall (mm) (2) soil moisture (%), and (3) soil temperatures (10 cm) (Graph 6).

It is known that annual clover seedling germination is regulated by a hardseededness mechanism which may promote persistence to plants growing in climatic areas where on occasions there is sufficient summer rain (Graph 6 -1) to promote germination but insufficient to sustain seedling growth on into autumn and winter.

The practice of removing dry plant through hard summer grazing before the initiation of autumn rains increases the temperature (Graph 6-2) fluctuations near the soil surface may in turn aid seedling germination and early seedling vigour.

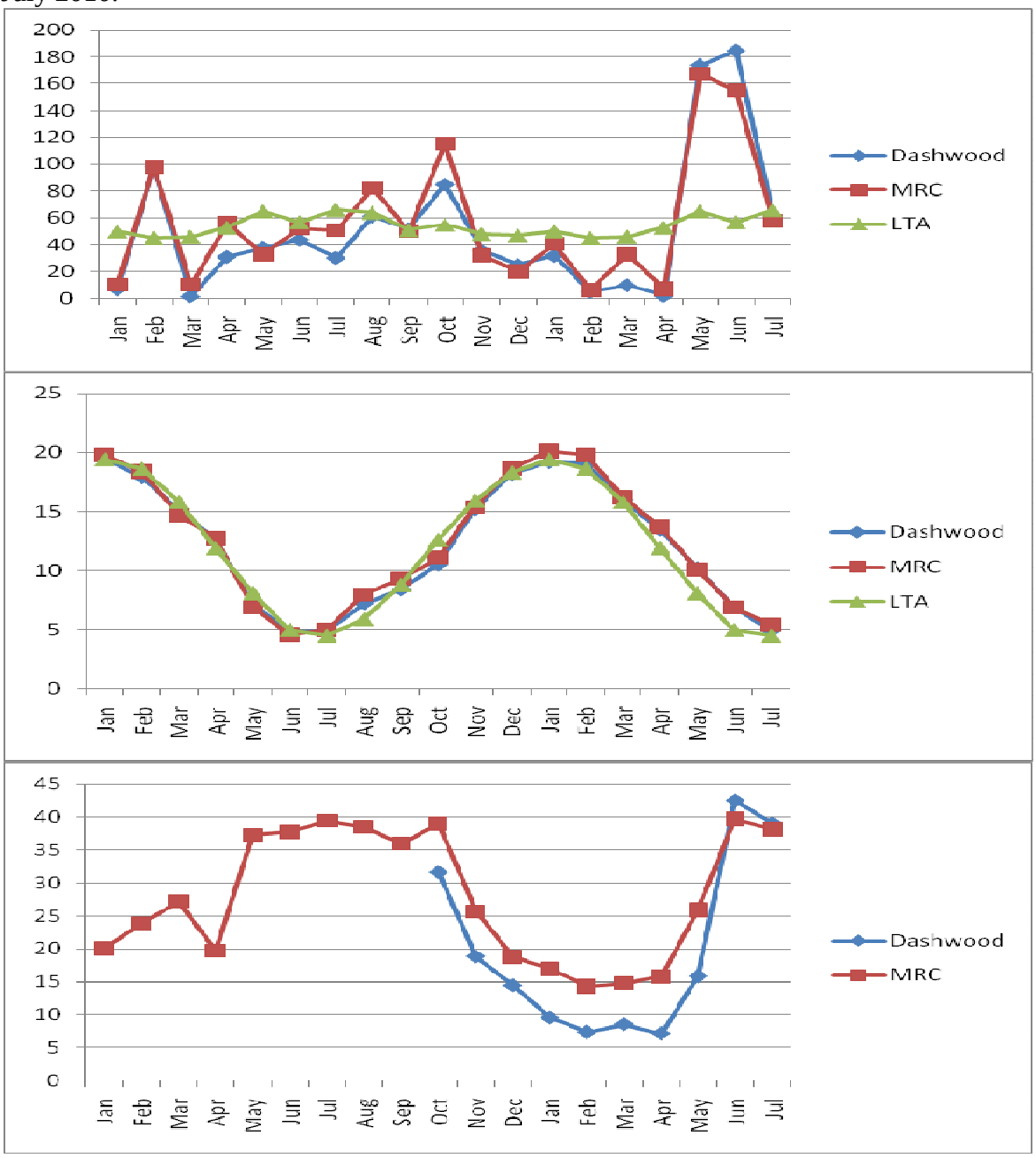
Another important characteristic of annual clovers especially subterranean clover seed dormancy may be governed by temperature, especially those hot temperatures during summer periods.

Germination is also dependant on a combination of adequate soil moisture (Graph 6-3) and favourable temperatures. In Marlborough autumn rains can be erratic and may range from January to May. This has been clearly the fact when rainfall for those periods in Marlborough, October 2009 to April 2010 accounted for only 139 mm against LTA 289 mm.

Temperature is also an important factor in defining the time and the rate of germination of clover seeds especially when water and nutrients are non-limiting. Subterranean clover seeds show a distinct germination response to temperature. Earlier investigations have shown that germination of 'Woogenellup' was at a maximum at 15^{o}C but that factor can be reduced dramatically if temperature rise to 20^{o} C plus. For this period Marlborough experienced temperatures November 09 – 20.3 C (LTA- 14.6 C), December 22.5 (16.7), January 10 – 23.6 (18.0), February 23.7 (17.8), March 23.1 (16.2, and April 20.6 (13.4) before temperatures fell to 15.8 (10.3) in May. What impact that had on the success of buried seed germination was not measured.

Soil moisture levels were also identified for this period, results for this periods November 09 until April 10, October 09 39% (LTA 32.3%), November 25.7 (24.0), December 18.8 (21.8), January 17.0 (20.2), February 14.3 (19.0), March 14.8 (19.6) April 15.8 (22.8).

Graph 6: Climatic data – rainfall mm, soil temeperature 10cm, soil moisture and long term average comparison sites Marlborough Research Centre and Dashwood – period Jan 2009 to July 2010.



Several environmental variables and plant individual plant characteristics within annual clover plants regulate the germination process. Within those terms

Discussion

Failure to gain MAF SF funding resulted in measurements being excluded from this trial (these will be carried through to 2010 and 2011 – MAF SFF application will be reapplied) will include, dry matter production (%), plant density, flowering prevalence in response to sowing rates, soil fertility, north south aspects, they will be determined in Spring and July of each year. Buried seed populations will identify and determine future clover production responses.

Climate; significant variables in Marlborough make establishment difficult to judge, the correct timing of application. All sites established were applied in early March. Climate variables and predictions, which include rainfall, temperature and soil moisture (Graph 6), identify the predicaments farmers face when making judgements as to sowing dates.

Weed control post establishment grazing herbicide area preparation. Resident weed populations are based on seed base accumulations over time. Many of these resident weed seed have been buried for indefinite periods, once disturbed they are free to germinate. Pre-establishment management is vital for best sown species establishment and survival. Use of pre-grazing treatment, herbicide and other crop rotations are required to ensure establishment best results for sown species are made. Weed populations within established sown annual clover species stands, were difficult to control and eradicate. Issues identified; were herbicide type, timing of application, rainfall, temperature, and crop cover. All of these issues require further investigation if annual clovers as an establishing crop is to be successful.

Soils, within paddock size area there are significant variations within soil type, clay loam, silt loam, stony loam they also clearly linked with varying soil temperature and soil moisture capacities, both essential for annual clover germination and persistence.

Annual clover species ecotype identification. The dilemma as to what annual clover best fits Marlborough climatically, geological, ecological and economically. There are significant selection lines available. Within those selection lines there are those classification that fit (1) early flowering, (2) mid-late flowering and (3) late flowering.

Publications

Field Day Marlborough Monitor Farm

ABSTRACT

Project Title: Adapting to change with legumes in summer dry Marlborough Hill Country. Hunter RM RMH & Associates Marlborough Research Centre Trust, Dawkins C Pyramid, Lissaman W Breach Oak, Grigg D Tempello, Lucas D Lincoln University. Clark B Kiwi Seed Marlborough.

Climate; significant variables in Marlborough make establishment difficult to judge, the correct timing of application. All sites established were applied in early March. Climate variables and predictions, which include rainfall, temperature and soil moisture identify the predicaments farmers face when making judgements as to sowing dates.

Weed control post establishment grazing herbicide area preparation. Resident weed populations are based on seed base accumulations over time. Many of these resident weed seed have been buried for indefinite periods, once disturbed they are free to germinate. Pre-establishment management is vital for best sown species establishment and survival. Use of pre-grazing treatment, herbicide and other crop rotations are required to ensure establishment best results for sown species are made. Weed populations within established sown annual clover species stands, were difficult to control and eradicate. Issues identified; were herbicide type, timing of application, rainfall, temperature, and crop cover. All of these issues require further investigation if annual clovers as an establishing crop is to be successful.

Soils, within paddock size area there are significant variations within soil type, clay loam, silt loam, stony loam they also clearly linked with varying soil temperature and soil moisture capacities, both essential for annual clover germination and persistence.

Annual clover species ecotype identification. The dilemma Marlborough farmers face with identification which annual clover best fits Marlborough climatically, geological, ecological, economically and management systems are required to ensure long-term persistence. There are significant selection lines available. Within those selection lines there are those classification that fit (1) early flowering, (2) mid-late flowering and (3) late flowering. This project is focusing on those issues.