1973 Research report

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SUMMARY

Clover Scorch (*Kabatiella caulivora*) has continued as the most serious pasture problem in established pastures in high rainfall areas and considerable effort has again been devoted to screening for disease resistance. Genetic resistance in the variety Daliak has been confirmed and the resistance introduced into a range of later maturing parents. Several other varieties have demonstrated a valuable degree of field tolerance and the best of these will be seed increased in 1974 and 1975.

Competition experiments showed the ability of the newer clovers Seaton Park, Midland B and 39313Y to compete successfully, with Yarloop, whilst Seaton Park in particular appears capable of replacing that cultivar in non waterlogged areas.

In waterlogged areas, although no *Kabatiella* resistant variety has been found, several low formononetin crossbreds have demonstrated winter growth equal to Yarloop, with greater total production in the case of some crossbreds, notably Y47, whose maturity is ideally suited to Yarloop growing areas in W.A. and other States.

The early maturing low oestrogen crossbreds compared favourably in seed production with the Geraldton cultivar at Merredin. Crossbred 175.1 significantly outyielded Geraldton whilst the other four crossbreds and Northam A did not differ significantly in seed yield during the favourable 1973 growing season.
1. **SUBTERRANEAN CLOVER IN THE HIGH RAINFALL AREAS.**

(A) **Clover Scorch Research.**

This joint programme with Dr. Chatel has proven very successful, having made a number of significant contributions toward the isolation of *Kabatiella* resistant subterranean clover cultivars.

(1) **Genetic Resistance of the Daliak Cultivar**

The heritability of Daliak's resistance, previously inferred from studies conducted on F₃ lines of a Bacchus Marsh x Daliak cross, has been confirmed by more detailed studies on F₂ populations of Midland B x Daliak and Shenton Park A x Daliak crosses. About 50 'resistant' plants from these crosses should provide enough seed for field testing in 1974. F₄ plants from the Bacchus Marsh x Daliak cross have also been grown for seed production and should also set adequate seed for field tests.

(2) **Other Varieties of Low Susceptibility to Kabatiella**

Toodyay C again showed a lower susceptibility to *Kabatiella* than Mt. Barker and set seed satisfactorily under a fairly extreme infection with *Kabatiella* at Denmark. It is about 5 days earlier flowering than Mt. Barker but its ultimate maturity appears about 1-2 weeks earlier and close to that of the Woogenellup cultivar. Three varieties were even less susceptible than Toodyay C, viz. 47308C, 47308D and Guildford D. 47308C and 47308D are low formononetin collections from Italy made by Dr. Gladstones. Guildford D was collected near Perth and has a moderate to high formononetin content. Guildford D closely resembles Daliak, is resistant to *Kabatiella*, and may be a natural Daliak cross. 47308C and D are about Mt. Barker maturity or slightly later but were mixed lines in 1973 which will delay any seed increase programme.

(3) **Selection for Kabatiella Resistance**

Multiple regression analysis techniques were used to relate *Kabatiella* susceptibility to a range of plant parameters. *Kabatiella* damage was positively related to leaf size and petiole width, and negatively to maturity.

.../2...
Varieties with pale leaves (probably a reflection of more rapid growth rate) were also more susceptible.

Comparison of varieties selected for low susceptibility in 1972 with the unselected 1973 population showed a highly significant \( p<0.001 \) selection differential in favour of the selected material; evidence for the value of the current 'debris spread' techniques in selection for Kabatiella tolerance in the field.

(B) New Cultivar Evaluation

(1) Midland B

The fourth year data from an experiment at Mt. Barker Research Station has as yet provided no evidence that the Midland B variety is more competitive than Woogenellup when sown in mixtures under heavy set stocking. Furthermore, cropping did not significantly influence the proportion of Midland B despite its higher seed reserve and considerably higher hard seed content. This experiment has provided some interesting data relevant to cropping as a technique of pasture regeneration (Table 1). Cropping at Mt. Barker removed silver grass infestation without reducing total dry matter production of the pastures. This was largely due to a considerable increase in the size of clover plants after cropping. This may be partly due to the removal of grass competition whilst root rot fungi (or Kabatiella) may build up, assisting in weakening the clover plants in the older pastures.
Table 1

EFFECT OF CROPPING ON CLOVER SIZE AND DENSITY - MT. BARKER.

<table>
<thead>
<tr>
<th>Pasture</th>
<th>Cultivar</th>
<th>Density (clover plants per dm²)</th>
<th>Size (mg/plant)</th>
<th>% grass</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fourth year</td>
<td>Woogenellup</td>
<td>37</td>
<td>17</td>
<td>32</td>
</tr>
<tr>
<td>Fourth year</td>
<td>Midland B</td>
<td>60</td>
<td>10</td>
<td>45</td>
</tr>
<tr>
<td>After Crop</td>
<td>Woogenellup</td>
<td>33</td>
<td>30</td>
<td>3</td>
</tr>
<tr>
<td>After Crop</td>
<td>Midland B</td>
<td>45</td>
<td>23</td>
<td>5</td>
</tr>
</tbody>
</table>

In a competition experiment with Yarloop and Seaton Park Midland B has to date not shown itself as good as the Seaton Park variety. Seaton Park in particular has invaded the Yarloop plots and appears capable of replacing Yarloop in non waterlogged areas provided grazing pressures are high (10 sheep/ha). The later maturing yanninicum 39313Y also improved its proportion in the mixtures despite a lower total seed yield; probably a reflection of a low hard seed content relative to Yarloop. (Table 2)

Table 2

Plant Establishment Counts. Competition plots Mt. Barker (second year pasture)

Per cent ... of 1st mentioned variety

<table>
<thead>
<tr>
<th>Seaton Park/Midland B</th>
<th>Yarloop/Mid.B.</th>
<th>Yarloop/S.Park</th>
<th>Yarloop/39313Y</th>
</tr>
</thead>
<tbody>
<tr>
<td>1972</td>
<td>56</td>
<td>55</td>
<td>45</td>
</tr>
<tr>
<td>1973</td>
<td>67</td>
<td>35</td>
<td>19</td>
</tr>
</tbody>
</table>

(2) Sub Species Yanninicum

Low formononetin crossbreds generally showed winter vigour equal to Yarloop, whilst later maturing varieties out yielded that cultivar in dry matter production at Denmark. (Table 3)
TABLE 3. PRODUCTION & MATURITY OF ssp. YANNINICUM CROSSBREDS (1973)

<table>
<thead>
<tr>
<th></th>
<th>Days 1st Flower</th>
<th>Senescence Rating 21st Nov.</th>
<th>Winter Production 4 cuts to mid Sept. Denmark Mt. Barker</th>
<th>Herbage Production 7 cuts to mid Nov. Mt. Barker</th>
<th>Seed Yield Denmark</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yarloop</td>
<td>111</td>
<td>.6</td>
<td>1499 1879</td>
<td>2207 3596</td>
<td>565</td>
</tr>
<tr>
<td>Dinninup</td>
<td>126</td>
<td>2.3</td>
<td>1453 -</td>
<td>2824 -</td>
<td>844</td>
</tr>
<tr>
<td>Seaton Pk.</td>
<td>110</td>
<td>.6</td>
<td>1009 1658</td>
<td>1687 3197</td>
<td>565</td>
</tr>
<tr>
<td>Woogenellup</td>
<td>136</td>
<td>3.3</td>
<td>1729 3066</td>
<td>4065 5203</td>
<td>736</td>
</tr>
<tr>
<td>39313Y</td>
<td>145</td>
<td>3.6</td>
<td>861 -</td>
<td>3163 -</td>
<td>834</td>
</tr>
<tr>
<td>Y26</td>
<td>174</td>
<td>.8</td>
<td>2075 1643</td>
<td>3531 3423</td>
<td>645</td>
</tr>
<tr>
<td>Y47</td>
<td>126</td>
<td>3.0</td>
<td>1647 2847</td>
<td>4034 5022</td>
<td>725</td>
</tr>
<tr>
<td>Y68</td>
<td>116</td>
<td>1.8</td>
<td>2135 2475</td>
<td>3733 4414</td>
<td>558</td>
</tr>
<tr>
<td>Y72</td>
<td>109</td>
<td>0</td>
<td>1578 2330</td>
<td>2061 3860</td>
<td>373</td>
</tr>
<tr>
<td>Y85</td>
<td>109</td>
<td>0</td>
<td>1587 2575</td>
<td>2255 4368</td>
<td>502</td>
</tr>
<tr>
<td>Y111</td>
<td>121</td>
<td>2.3</td>
<td>1874 2512</td>
<td>3432 4368</td>
<td>743</td>
</tr>
<tr>
<td>Y155</td>
<td>115</td>
<td>1.1</td>
<td>1490 1751</td>
<td>1918 3694</td>
<td>564</td>
</tr>
<tr>
<td>LSD (p .05)</td>
<td></td>
<td></td>
<td>520 N.S.</td>
<td>942 1521</td>
<td>N.S.</td>
</tr>
</tbody>
</table>

* 0 = dried off  
4 = no senescence  
+ kgs/hectare

Y47 is the most promising of the low oestrogen yanninicum crossbreds, this years data confirming 1972 results. It is slightly earlier than Woogenellup, but is late enough to enable a late Oct. hay cut, and is potentially a much more valuable clover than Yarloop in virtually all areas subject to winter waterlogging of this and other states.

Y47 despite Kabatiella susceptibility can be recommended for release to farmers. A waterlogging tolerant variety of formononetin content 0.07 per cent (c.f. Yarloop 2.0 per cent); it is more productive than Yarloop and of maturity better suited to winter waterlogging areas, where Yarloop is frequently too early to take full advantage of the long growing seasons such areas usually offer.
2. DEVELOPMENT OF EARLY MATURING SUBTERRANEAN CLOVERS.

The development of the advanced generation (F7) early maturing crossbreds underwent three phases in 1973.

(A) Evaluation in rows

The continued testing for maturity and hard seed content from about 60 crossbreds at Wongan Hills and Merredin and Perth. Accurate flowering time data in the country centres was derived by pegging individual flowering plants every 2nd day. The work was carried out most efficiently by Department of Agriculture Research Station staff. Hard seed tests on the 1973 seed has commenced. Seed from rows at Geraldton are included in these tests and with this data and that already available from 1971 and 1972 final selections for field evaluation will be made. It is aimed to finish with 12-15 crosses in the 1974 field plot trials.

Although in the previous year (1972) flowering time of Geraldton and its crossbreds was relatively earlier in the inland centres than at Perth; this effect was not so apparent in 1973, a very much more favourable year from the plant growth viewpoint.

Crossbreeding has succeeded in producing a number of clovers with maturity earlier than the Geraldton cultivar, and 1973 data has supported previous evidence that transgression for flowering data has occurred with crossbreds earlier than either parent. (Table 4.)

e.g. 29.1, 173.1, 175.1. c.f. Northam A:Cross 492.1 is the earliest of the Geraldton x Daglish crosses and with a rapid rate of maturation is also distinctly earlier than either parent.
TABLE 4  MATURITY OF EARLY CROSSBREDS.

Cross Parents | Days to first Flower | | |
---|---|---|---|
Northam A x Daglish (Shenton Park) | | | |
*29.1 | 79 | 74 | 77 |
*66.2 | 82 | 77 | 78 |
*92B | 80 | 77 | 78 |
*93B | 80 | 75 | 78 |
*173.1 | 78 | 76 | 77 |
*175.1 | 78 | 74 | 77 |
*230.1.2 | 78 | 76 | 84 |
*231.2B | 79 | 78 | 77 |
*337.1 | 82 | 75 | 77 |
Geraldton x Daglish | | | |
396.2 | 87 | 86 | 84 |
457.1 | 84 | 81 | 83 |
480B | 85 | 82 | 83 |
*492.1 | 82 | 81 | 81 |
*503.1 | 86 | 80 | 83 |
547.1 | 89 | 81 | 83 |
*584.1 | 86 | 81 | 82 |
598.1 | 84 | 81 | 82 |
Controls | | | |
Northam A | 81 | 78 | 78 |
Dwalganup | 88 | 82 | 83 |
Daglish | 84 | 79 | 81 |
Geraldton | 97 | 88 | 86 |

* Included in Seed Increase Plots Medina.

(B) Seed Increase.

Seed increase of 12 crossbreds listed above together with control seed of Northam A and Geraldton, was carried out at Medina, largely organised by Dr. B.J. Quinlivan of the Weeds and Seeds Branch. Larger scale seed increase on a 'best bet' basis will proceed at Esperance in 1974 of 3-5 selected crosses one of which will be 175.1 (See below).

(C) Initial small plot evaluation of crossbreds.

For initial small plot evaluation, 2m x 1m plots (4 reps) were seeded at 75 kg/ha, and received two mowings during the winter months. The plots made excellent growth but the need for increased replication was obvious to achieve better precision. In 1974 light grazing will replace mowing treatments. The results were however most encouraging, in a favourable season where the greater earliness of the crossbreds may have offered little premium. (Table 5).
**TABLE 5**

Low Oestrogen Early Sub Clover Crossbreds

Small plot yields kg/ha - Merredin Research Station.

<table>
<thead>
<tr>
<th>Variety or Crossbred</th>
<th>Seed Yield</th>
<th>Days to 1st Flowering</th>
</tr>
</thead>
<tbody>
<tr>
<td>175.1 (Northam x Daglish)</td>
<td>590.7</td>
<td>77</td>
</tr>
<tr>
<td>93B (Northam A x Daglish)</td>
<td>473.8</td>
<td>78</td>
</tr>
<tr>
<td>NORTHAM A</td>
<td>447.6</td>
<td>78</td>
</tr>
<tr>
<td>503.1B (Geraldton x Daglish)</td>
<td>443.0</td>
<td>83</td>
</tr>
<tr>
<td>DAGLISH</td>
<td>436.5</td>
<td>81</td>
</tr>
<tr>
<td>GERALDTON</td>
<td>377.4</td>
<td>86</td>
</tr>
<tr>
<td>5841.B (Geraldton x Daglish)</td>
<td>331.7</td>
<td>82</td>
</tr>
<tr>
<td>337.1B (Northam x Daglish)</td>
<td>311.1</td>
<td>77</td>
</tr>
<tr>
<td>DWALGANUP</td>
<td>263.5</td>
<td>83</td>
</tr>
</tbody>
</table>

LSD. \( p < .05 = 132 \)
\[ p < .01 = 190 \]

The seed yield of the crossbreds generally was very promising when considered in relation to Geraldton. 175.1 flowers at about the same time as Northam A but produces its flowers at a faster rate, so that in 1973 it was the earliest variety tested. Northam A, a low oestrogen variety being considered for seed increase, performed well in the trial and made impressive growth, though at slightly higher establishment densities than the other test lines.
3. SUBTERRANEAN CLOVER BREEDING.

$F_3$ rows of early maturing crosses were screened for maturity, growth habit, and formononetin content in 1973. These crosses are designed to widen the genetic base on which the early crosses are based, the current programme is evaluating derivatives of only two crosses viz. Northam A x Daglish and Daglish x Northam A.

The additional crosses are Northam A x Geraldton, Mt. Helena A x Daglish, Dalkeith x Northam A, Northam C x Daglish, Bellvue x Northam A, Bellvue x Daglish, Dalkeith x Bellvue, Midland B x Daglish. In all 325 plants were selected for growing in $F_4$ rows in 1974. Rows will be planted at Perth and Wongan Hills.

A number of crosses (53) were made in 1973 in an attempt to incorporate Daliak resistance to Kabatiella into a range of varieties of late maturity. Perhaps the most interesting are Daliak x H.20 (a stunt virus resistant crossbred) and Daliak x Yarloop. The later cross is an interspecies cross and its success of vital importance to Kabatiella resistance breeding as no sources of resistance have been found in ssp. yanninicum, clovers which grow most typically in wet areas ideally suited to Kabatiella.
PUBLICATIONS.


Accepted for publication.


Francis C.M. and Quinlivan B.J. Selection for formononetin content in red clover (Trifolium pratense), proceeding XII International Grasslands Congress, Moscow 1974.
