Seed and herbage production and cyanogenic potential of white clover cultivars under irrigation at Neuarpurr, Victoria

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Summary. Forty-eight cultivars of white clover, *Trifolium repens,* were sown at Neuarpurr, western Victoria in 1988 to determine seed production potential. Seed yields in the first year were generally low, but five cultivars gave seed yields at least equal to Haifa. Seed yields in 1989 ranged from 488-1,291 kg/ha; only eight cultivars had yields significantly lower than Haifa. In spring 1988, 27 cultivars had growth scores equal to Haifa. In winter 1989, only seven cultivars had significantly less growth ($P<0.05$) than Haifa. The cyanogenic potential of the cultivars ranged from 13-1,398 g HCN/g DM in September 1989; all cultivars showed reduced levels when re-sampled in November.

Introduction

White clover is the most important pasture legume in the world. International trade in seed is estimated to be in excess of 5,000 tonnes annually and is worth $13 million.

Australian production of Haifa white clover seed increased dramatically in the mid 1980s when centre-pivot irrigation was widely adopted for seed production in SA (see Fig. 1). Prior to this the commercial yields were usually low (1). The price paid to the grower has fluctuated between $3 to $6 per kg in recent years. Virtually all seed produced is used in Australia and indications are that the domestic market is unlikely to require more Haifa seed. There is great potential therefore for Australian (and especially Victorian) white clover seed producers to export Haifa and to grow overseas cultivars for re-export.

Figure 1. Certified seed production of Haifa white clover in Australia, 1977-1990.

The Neuarpurr district of western Victoria is well placed for white clover seed production. It has an excellent supply of good quality artesian water and has no white clover seed contamination - a major problem in many countries. The aim of this experiment was to determine whether successful seed crops of overseas cultivars of white clover could be produced at Neuarpurr. In addition the opportunity was taken to assess a wide range of material for seasonal herbage production and cyanogenic potential. The presence of cyanide may contribute to pest resistance but low cyanide types are favoured under certain climatic or edaphic conditions (2).

Methods

An experiment was established to determine the seed yield, seasonal growth and cyanogenic potential of a range of white clover cultivars, under spray irrigation at Neuarpurr in north-west Victoria. Forty-eight

white clover cultivars from 16 countries were sown on 15 May 1988. The sowing rate was 4 kg/ha and the plots were 5x1 m. The design was a randomised block with four replicates.

The experiment was sown into a cultivated seedbed with 200 kg/ha of a 1:1 superphosphate-lime mixture containing molybdenum (0.05%). Tribunil was applied to control capeweed, *Arctotheca calendula,* in the establishment year. An additional 250 kg/ha of superphosphate was applied in spring 1989. Weeds (mainly Ox-tongue, *Picris echioides)* were controlled with Sprayseed in June 1989. Sufficient beehives were located near the trial during flowering to allow for a high rate of pollination.

Seed production was measured by direct heading in January 1989 and January 1990. On the first occasion, material collected with a lawn mower was thrashed. On the second, three 15x15 cm quadrats per plot were cut with hand shears and thrashed.

Clover yield was visually assessed in spring 1988 and in winter 1989. Plots were rated on a 1 to 9 scale where 1 = poor and 9 = excellent herbage production.

The cyanogenic potential of the herbage (dried at 65?C) was measured using the modified picric acid procedure developed at CS IRO, Armidale (Pickering, unpublished data). All cultivars in replicate 1 were measured in September 1989 with selected cultivars (covering the range of cyanide levels found on the first sampling date) re-analysed in November 1989.

Results and discussion

All results are presented in Table 1.

Seed yield

First year seed yields were low due to adverse climatic conditions which also saw commercial yields fall. It is likely the yields were reduced by the choice of harvesting technique. Only five cultivars gave seed yields at least equal to Haifa. In the second year, seed yields were in the range 488-1,291 kg/ha with all but eight cultivars yielding as much seed as Haifa. These results suggest that successful seed crops of overseas white clover cultivars can be grown at Neuarpurr for re-export.

Clover yield

In 1988, 27 cultivars had spring growth scores equal to Haifa while in winter 1989 all but seven cultivars produced as much herbage as Haifa.

Cyanogenic potential

Cyanide levels in one replicate in September, 1989 ranged from 13-1398 g HCN/g DM while in November, 1989 the cyanide levels for each cultivar had fallen consistently by a factor of 5 to 6 reflecting the increased maturity of the foliage and the increasing temperatures. This agrees with the findings of Vickery *et al.* (3) who showed that leaf maturity and high temperatures were among the factors leading to a decrease in cyanide content of white clover. A wide range of cyanide production potential was to be expected amongst the cultivars as HCN levels have been shown to be related to geographic origin (2).

The authors believe that the results reported here support the development of a white clover seed re-export industry based at Neuarpurr. Most of the overseas cultivars were capable of producing high seed yields especially in the second year when the harvesting technique was successful. Seed producers need to be aware of the differences in maturity type between the overseas cultivars and the Australian cv. Haifa and manage the crops accordingly by delaying the closing and harvesting times for the later maturing cultivars.

Table 1. Seed production, rated clover production and cyanogenic potential of 48 white clover cultivars at Neuarpurr, western Victoria (N=not assessed).

Cultivar	Origin	Seed production (kg/ha) 1988	1989	Rated clover production (1=poor to 9=excellent) 24.11.88	06.09.89	Cyanogenic potential (µg HCN/g DM) 06.09.89	30.11.89
81403	Ireland	14	980	3.0	3.7	363	N
82435	Ireland	16	709	4.3	3.7	262	N
Alice	UK	45	893	6.3	6.3	740	N
Aran	Ireland	15	751	4.3	7.0	1181	282
Barbian	Holland	6	685	2.3	2.3	329	55
Bayucua	Uruguay	102	848	4.3	5.0	683	N
Blanca	Belgium	14	778	3.7	5.0	861	N
Donna	UK	12	1131	3.0	5.0	711	N
El Lucero	Argentina	170	758	6.3	6.3	756	122
Espanso	Italy	5	488	3.7	5.7	31	6
Gandalf	Denmark	9	603	4.3	3.7	44	16
G. Huia	NZ	24	810	3.0	4.3	393	120
G. Kopu	NZ	33	1143	5.0	5.7	496	N
G. Pitau	NZ	25	903	3.7	3.7	543	N
G. Tahora	NZ	35	1001	1.7	3.7	236	81
H 27 F	Ireland	12	909	5.0	5.0	749	N
H 27 M	Ireland	14	597	5.0	7.0	738	N
H 27/17 R2	Ireland	22	670	6.3	8.3	671	229
H 27/23 R1	Ireland	23	994	4.3	6.3	516	N
H 27/27 R1	Ireland	80	1230	5.0	5.7	476	N
Haifa	Australia	164	1211	6.3	5.0	1115	N
Irrigation	Australia	146	1246	6.3	7.7	360	N
Karina	Germany	8	850	4.3	5.0	327	N
Lirepa	Germany	21	1104	3.0	2.3	282	N
Lustar	France	13	934	3.7	6.3	1398	N
Menna	UK	19	1147	5.0	6.3	630	179
Merwi	Belgium	32	857	3.7	5.7	771	N
Milka	Denmark	22	1132	3.7	3.0	378	42
Milkanova	Denmark	27	841	5.0	5.0	161	N
Milo	Denmark	10	1006	1.7	2.3	203	N
Nesta	UK	17	1003	3.7	5.0	778	N
NFG Gigant	Germany	10	1202	4.3	5.0	107	19
Olwen	UK	17	698	5.0	7.0	938	N
Podkowa	Poland	10	976	1.7	3.0	13	N
Radzikowska	Poland	13	1032	5.0	4.3	100	N
Ramona	Sweden	12	745	4.3	5.0	499	156
Retor	Holland	17	926	3.7	3.7	38	N
Rivendel	Denmark	12	839	2.3	3.0	149	26
Ross	Ireland	43	1190	7.0	6.3	1044	N
S 184	UK	8	681	3.7	3.0	252	N
Seedco White	Australia	122	1280	5.7	6.3	724	N
Siral	Algeria	30	811	3.7	5.0	181	N
Siwan	UK	11	824	4.3	5.7	687	226
Sonja	Sweden	15	930	3.0	3.7	365	N
Steinacher	Germany	32	1163	4.3	3.7	352	N
Susi	Ireland	43	1051	4.3	6.3	739	N
Tamar	Israel	121	1132	5.0	5.7	806	169
Zapican	Uruguay	134	1291	6.3	4.3	674	N
l.s.d. (P=0.05)		49.2	468.4	2.38	1.77	-	-

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