Cultivar Description

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Grasslands NuSiral white clover (*Trifolium repens* L.)

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Abstract. Grasslands NuSiral is a medium–large-leaf white clover (*Trifolium repens* L.) cultivar with intermediate growth habit (midway between open and erect and dense and prostrate), early flowering maturity and high growing point density. G. NuSiral possesses the plant-type attributes known to be desirable for broad adaptation to dryland pasture conditions in Australia and has been developed for cattle and sheep pastures in both summer rainfall and winter rainfall areas where average annual rainfall exceeds 750 mm. G. NuSiral is expected to provide enhanced stolon survival and autumn recovery in environments where summer moisture stress is present but not intense, and winter growth comparable to cv. Haifa where mild winter conditions allow the expression of G. NuSiral's winter activity.

Origin

G. NuSiral was bred by J. R. Caradus and P. T. P. Clifford, AgResearch Ltd, Palmerston North, New Zealand. It is a synthetic cultivar developed by phenotypic selection from 3 cycles of single plant selection from a random population of 500 plants sampled from breeder seed of cv. Siral, maintained by NSW Agriculture. Siral was developed from an introduction (CPI 19434) collected in the Tel Atlas region near Medea (elevation 820 m, average annual rainfall 850 mm, winter rainfall incidence) in Algeria during an FAO–CSIRO collecting mission to the Mediterranean region in 1954 (Anon. 1990). Siral has strong winter growth in mild climates, good vegetative recovery characteristics following summer–autumn moisture stress and broad adaptation (Wright 1972; Lovett and Neal-Smith 1974; Anon. 1990). In a 'plant-environment matching' study of 17 prominent white clover cultivars at 18 field sites across the Australian white clover zone, Siral showed good performance at both winter rainfall sites (e.g. Kyabram, Timboon and Hamilton in Victoria) and summer rainfall sites (e.g. Glen Innes, Inverell and Grafton in New South Wales), and expressed outstanding cool season performance attributed to (i) good stolon survival through summer–autumn moisture stress and (ii) ability to produce late autumn–early winter regrowth (Norton *et al.* 1995). However, poor seed production (Clark *et al.* 1990) led to withdrawal of Siral from commercial use.

To overcome this limitation in Siral, selection within Siral was undertaken in the field at Lincoln, New Zealand commencing in 1994 for: (i) intensive flowering and high seed production, (ii) uniformity of vegetative characteristics, (iii) improved autumn production, and (iv) absence of alfalfa mosaic virus symptoms. The primary selection criteria were increased seed yield potential and disease resistance. Forty-nine plants were selected from the original nursery population. To ensure equal pollen contribution, the plants were cloned on the basis of the relative number of inflorescences/m^2. Maternal lines were harvested independently and equal seed weights combined to form the Syn I generation seed. G. NuSiral was granted PBR status in March 1999 (Anon. 1999).

Cultivar characteristics

Observations (Anon. 1999) under spaced plant nursery conditions at Palmerston North, New Zealand (latitude 40°23′S, elevation 33 m) of G. NuSiral in comparison with 8 cultivar comparators (G. Bounty, G. Pitau, G. Challenge, G. Sustain, G. Demand, G. Huia, Le Bons, Irrigation) showed G. NuSiral to be: (i) intermediate in growth habit and medium in plant height; (ii) long in leaf length and medium in leaf width, white crescent leaf markings in 86% leaves, anthocyanin leaf flecks in <5% leaves, 96% cyanogenic frequency; (iii) medium in stolon thickness with long internode length; (iv) peduncle medium–short in length and medium in thickness, flowers predominantly white but 3% with pink hue, thousand-seed weight 0.88 g.

Characterisation measurements (Lane *et al.* 2000) from mixed sward plots under grazing at Armidale, New South Wales (latitude 30°31′S, elevation 1050 m, 793 mm average annual rainfall), show that G. NuSiral is a medium–large-leaf cultivar (leaf area 178 mm^2) intermediate between G. Sustain (123 mm^2) and Haifa (263 mm^2). G. NuSiral retains relatively stable leaf size across seasons. In a 24-month (May 1999–April 2001) field study at Armidale (J. F. Ayres and L. A. Lane unpublished data), NuSiral retained medium–large leaf size on 21 of 24, 6-weekly measurement occasions and reverted to medium leaf size only during severe summer moisture stress in January 2000, March 2000 and February

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2001. White crescent leaf marking is strongly defined in G. NuSiral but is not as pronounced as in Haifa. The stolon thickness of G. NuSiral (2.7 mm) was comparable with large-leaf cultivars like Haifa (2.8 mm), Waverley (2.9 mm) and El lucero (2.7 mm). Notably, the stolon density of G. NuSiral (213 stolons/m^2) was greater than Haifa (167 stolons/m^2) and comparable to G. Sustain (213 stolons/m^2) and Irrigation (222 stolons/m^2). The growing point density of G. NuSiral (113) was relatively high (Haifa: 73, Waverley: 69, G. Sustain: 102, Irrigation: 102, El lucero: 89, G. Prestige: 140 number/m^2). In the Armidale environment, G. NuSiral expressed exceptionally high seed yield potential as indicated by high flowering prolificacy (G. NuSiral: 687, Haifa: 440, Waverley: 340, G. Sustain: 527, Irrigation: 367, El lucero: 427, Prestige: 627 flowers/m^2).

Under dryland conditions in northern New South Wales, G. NuSiral initiates flowering from early October and has a comparable flowering pattern to Haifa; both cultivars are substantially earlier in initiation of flowering and onset of full bloom than G. Huia or G. Sustain (J. F. Ayres and L. A. Lane unpublished data). Accordingly, G. NuSiral is classified as an early season flowering cultivar possessing exceptionally high flowering prolificacy. G. NuSiral is intermediate in presence of cyanogenic glucosides (758 µg HCN/g DM, 82% cyanogenic frequency) and has high digestibility while vegetative (81.1% *in vitro* digestibility) and exhibits a slight decline with onset of phenological maturity (full bloom: 78.4% *in vitro* digestibility, ripe seed stage: 78.6% *in vitro* digestibility) that is characteristic of white clover in the spring primary growth phase (Ayres *et al.* 1998).

Agronomic performance

In comparison with the original Siral population, the selection program that developed G. NuSiral achieved: 18% improvement in the uniformity of leaf size; 16% reduction in variability of plant habit by removing prostrate/dense stolon variants; 12% improvement in autumn recovery and 16% improvement in early winter growth; 97% increase in seed yield (1240 *v.* 630 kg seed/ha) associated with a 48% increase in flowerhead density (930 *v.* 630 inflorescences/m^2) and a 35% increase (133.6 *v.* 98.7 mg seed/inflorescence) in seed yield per inflorescence (P. T. P. Clifford, unpublished data).

G. NuSiral has been evaluated in 2 by 1 m mixed sward (clover–tall fescue) grazed plots (5 reps) at Glen Innes (29°42′S, 1060 m elevation, 847 mm average annual rainfall) and Armidale (30°31′S, 1050 m elevation, 793 mm average annual rainfall) in New South Wales during 1998–2001, and merit tested under APPEC (Australian Plant Production Evaluation Committee) protocols (15 m^2 mixed sward grazed plots 26 reps) at Glen Innes, Armidale and Nowra (34°57′S, 109 m elevation, 1153 mm average annual rainfall) against Haifa and G. Huia check cultivars. Merit testing is also occurring at 3 sites in Victoria and in New Zealand, Europe, USA and S. America but data for these sites are presently unavailable.

In the evaluation trials at Glen Innes and Armidale, G. NuSiral out-performed Haifa in early spread (from the planted row) in the establishment year; G. NuSiral achieved 50 cm spread at Armidale and 30 cm spread at Glen Innes compared with 40 cm and 20 cm for Haifa at Armidale and Glen Innes, respectively. In the 2nd growth cycle (March

Table 1. Seasonal herbage yield (kg DM/ha) of G. NuSiral compared with cultivar checks at three sites in New South Wales: Nowra, Armidale and Glen Innes

Values are means with l.s.d.s for comparing means within columns

	Nowra												
	15.v.97[A]	22.viii.97	22.ix.97	30.x.97	13.i.98	21.v.98	16.vii.98	28.viii.98	17.ix98	21.x.98	25.xi98		
G. NuSiral	212	0.12	0.31	0.66	0.04	0.10	0.16	0.09	0.50	0.30	0.24		
Haifa	199	0.15	0.36	0.74	0.10	0.10	0.26	0.13	0.57	0.32	0.20		
Huia	180	0.07	0.25	0.36	0.04	0.10	0.05	0.07	0.39	0.27	0.30		
l.s.d.	48	0.053	0.115	0.262	0.036	0.064	0.077	0.054	0.185	0.156	0.220		
	Armidale												
	9.x.98[B]	20.x.98[C]	23.xi.98[C]	9.iii.99	19.v.99[C]	28.vi.99	15.ix.99	23.xi.99	14.iv.00[C]	28.vi.00	19.ii.00	6.xii.00[C]	21.iii.01[C]
G. NuSiral	38	3.1	7.0	0.05	8.2	5.1	0.08	0.83	4.8	0.07	0.28	0.1	8.9
Haifa	31	2.5	6.3	0.06	6.3	4.2	0.09	0.62	4.8	0.02	0.10	0.2	4.1
Huia	47	2.7	6.3	0.07	8.0	5.5	0.04	1.34	3.1	0.12	0.38	0.2	5.0
l.s.d.	6.7	—	—	0.024	—	—	0.052	0.246	—	0.052	0.166	—	—
	Glen Innes												
	8.x.98[B]	19.x.98[C]	23.xi.98[C]	9.iii.99	15.v.99[C]	29.vi.99[C]	7.ix.99	10.xi.99	12.iv.00[C]	5.vii.00[C]	5.ix./00[C]	8.xii.00[C]	11.iv.01[C]
G. NuSiral	33	3.2	8.5	0.46	7.8	6.2	0.12	0.42	0.5	1.2	1.1	0.9	0.8
Haifa	31	3.2	7.0	0.23	5.5	3.5	0.10	0.36	2.0	2.8	1.8	2.0	1.8
Huia	29	2.5	6.2	0.38	6.5	4.0	0.03	0.39	0.3	0.3	0.3	0.5	0.2
l.s.d.	8.3	—	—	0.114	—	—	0.038	0.177	—	—	—	—	—

[A]Number of white clover seedlings/m^2. [B]Number of white clover seedlings per metre length of row.
[C]Yield rating (0–9 linear scale where 1 is lowest yield, 9 is highest yield) used where insufficient clover herbage mass was available to harvest.

1999–February 2000), under adverse seasonal conditions, G. NuSiral outperformed Haifa at Armidale and this was associated with better stolon survival through summer moisture stress, increased autumn regrowth and enhanced winter growth. At Glen Innes, summer moisture stress was more intense and all cultivars in the trial declined to low levels. In the 3rd growth cycle (March 2000–February 2001) at Armidale, both G. NuSiral and Haifa maintained similar growth and presence but both cultivars declined to about 20% presence due to severe moisture stress in the third summer of the trial.

G. NuSiral was evaluated by the APPEC merit testing procedures at the 3 sites in New South Wales (Nowra 1997–98, Armidale 1998–2001, Glen Innes 1998–2001). Results are summarised in Table 1. At the Armidale merit testing site, G. NuSiral established with a lower seedling density than G. Huia but in the establishment year, G. NuSiral showed higher winter growth. In the 2nd growth cycle, autumn and winter growth performance of G. NuSiral, G. Huia and Haifa was comparable but spring growth favoured G. Huia. In the 3rd growth cycle, both G. NuSiral and Haifa out-performed G. Huia in both autumn recovery and winter growth but spring growth of the 3 cultivars was comparable. All cultivars declined to nil presence following severe moisture stress in summer 2000–2001. At the Glen Innes site in the establishment year, G. NuSiral and Haifa out-performed G. Huia in winter growth, G. NuSiral showed best spring growth and G. NuSiral showed better summer growth than Haifa. In the 2nd growth cycle, G. NuSiral showed best autumn recovery from summer moisture stress, equal best winter activity but all cultivars declined to trace presence in the 3rd growth cycle following severe summer moisture stress in 1999–2000. At the Nowra site, data are available only for 2 years of the 3-year trial because kikuyu (*Pennisetum clandestinum*) progressively invaded the trial-site leading to demise of all white clover cultivars due to grass competition. In the establishment year, G. NuSiral and Haifa equally out-performed G. Huia in winter growth and spring growth. In the second year, there were no significant differences between the cultivars in winter or spring growth but it is noteworthy that G. NuSiral and Haifa significantly outyielded G. Huia in cumulative herbage yield summed over the 10 harvests of the 2-year trial (G. NuSiral: 2.52, Haifa: 2.91 > G. Huia 1.89 t DM/ha; l.s.d.: 0.567).

A number of on-farm pasture trials and demonstrations based on G. NuSiral have been established by Pacific Seeds Pty Ltd in a wide range of environments in Australia including south-east Queensland, coastal and tablelands New South Wales, irrigated dairy pastures in northern Victoria and low rainfall dryland districts in south-west Victoria, and Western Australia. Anecdotally, farmer experience indicates that G. NuSiral shows early vigour and high yield performance (B. Jamieson pers. comm).

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References

Anon. (1990) White clover (*Trifolium repens*) 'cv. Siral. Reg. No. 3-1a-6'. In 'Register of Australian Herbage Plant Cultivars'. (Ed. RN Oram) pp. 115–116. (CSIRO Australia)

Anon. (1999) White clover (*Trifolium repens*) 'Grasslands NuSiral'. *Plant Varieties Journal* **12**, 65-67.

Ayres JF, Nandra KS, Turner AD (1998) A study of the nutritive value of white clover (*Trifolium repens* L.) in relation to different stages of phenological maturity in the primary growth phase in spring. *Grass and Forage Science* **53**, 250–259.

Clark S, Taylor J, Smith K (1990) 'Winter growth, seed production and cyanogenic potential of white clover cultivars under irrigation at Neuarpurr, Victoria.' Victorian Department of Agriculture and Rural Affairs, Report No. 2.

Lane LA, Ayres JF, Caradus JR, Clifford PTP (2000) Grasslands NuSiral — a new white clover cultivar for dryland pastures. In 'Proceedings of the 15th annual conference of the NSW Grasslands Society'. Armidale 2000. (Ed. W McDonald) pp. 114–115. (Grassland Society of NSW Inc.: Orange)

Lovett JV, Neal-Smith CA (1974) The performance of introduced lines of white clover (*Trifolium repens* L.) and red clover (*Trifolium pratense* L.) grown at Canberra, ACT and Armidale, NSW. *Australian Plant Introduction Review* **10**, 20 2–29.

Norton MR, Jahufer MZZ, Lane LA, FitzGerald RD, Ayres JF (1995) 'White clover improvement — national field testing of the Australian white clover collection.' Final Report DAN 104, International Wool Secretariat. ISBN 0731056752.

Wright WA (1972) White clovers give more winter production. *Agricultural Gazette NSW* **83**, 127–128.