New herbage plant cultivars

B. Legumes

1. Clover

(d) *Trifolium subterraneum* L. var. *subterraneum* (Katz. et Morley) Zohary and Heller (subterranean clover) cv. Goulburn

Reg. No. B-1d-28. Registered on October 21, 1991.

Originators: National Subterranean Clover Improvement Programme, c/- Western Australian Department of Agriculture, Baron-Hay Court, South Perth, W.A. 6151, Australia.
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Origin

Goulburn was collected in Sardinia by C.M. Francis and D.J. Gillespie in June 1977, 13 km north of Luagosanto (41.13 °N, 9.29 °E). It was given the collector's code of CD 65 Sub D (Gorringe and Pullen 1983). The collection site consisted of a grey, gritty granitic sand of pH 5.5, located at an altitude of 300 m and with mean annual rainfall of 750 mm. The site was well grazed at the time of collection.

Goulburn was selected in 1982 by J.S. Gladstones and W.J. Collins as one of 102 late-midseason to late maturing breeding lines for distribution to collaborators of the National Subterranean Clover Improvement Programme (Gladstones 1983) in Western Australia, New South Wales, Victoria and South Australia, for initial field evaluation. Evaluation of 93 of these lines commenced in Tasmania in 1983. It entered final stage field evaluation trials in 1987 at 29 sites in Western Australia, New South Wales and Victoria and Tasmania. Selection and testing was conducted under the name CPI 8983OF.

Field evaluation and final selection of Goulburn were conducted by the following collaborators of the National Subterranean Clover Improvement Programme: B.S. Dear (New South Wales Agriculture), D.A. Nicholas and P.G.H. Nichols (Western Australian Department of Agriculture), K.F.M. Reed and S.G. Clark (Victorian Department of Agriculture), J.A. Carpenter and P.M. Evans (Tasmanian Department of Primary Industry) and P.E. Beale, M.J. Cochrane, G.J. Mitchell and I.D. Kaehne (South Australian Department of Agriculture). Screening for disease and insect resistance was conducted by D.J. Gillespie, M.J. Barbetti and J.D. Sandow (Western Australian Department of Agriculture). Phytophthora root rot screening was conducted by P.A. Taylor and S.P. Flett (Victorian Department of Agriculture). Virus screening was conducted by G.R. Johnstone (Tasmanian Department of Primary Industry). Isoflavone analyses were provided by W.R. Stern and B.H. Tan (University of Western Australia).

Submitted for registration by the collaborating organizations of the National Subterranean Clover Improvement Programme and recommended for registration by the New South Wales and Western Australian Herbage Plant Liaison Committees. The Western Australian Department of Agriculture will maintain breeders' seed.

Morphological description

Leaflets of Goulburn are heart-shaped with a moderate indentation. They contain a pale green, narrow crescent extending about two-thirds of the distance to the margin, flanked by white arms. This leaf-mark pattern is classified as C_2A_{1-2}, using the system of Collins *et al.* (1984). Under cold and other growth-limiting conditions, leaves exhibit a brown anthocyanin flush along the midrib and surrounding the crescent and arms. Anthocyanin leaf flecking is absent. Stipule pigmentation under shaded conditions is weak. Goulburn averages 4.7 florets per inflorescence in undefoliated rows. Corollas are pink-veined, while calyx tubes have a purplish-red anthocyanin pigmentation on their proximal half. Stems are green and glabrous. Petioles and upper leaf surfaces have a few erect hairs. Peduncles are

glabrous to weakly hairy along most of their lengths, but strongly hairy near the calyx junction.

Seedlings of Goulburn are fine and moderately small. Growth habit is moderately prostrate in the early stages but becomes semi-erect post-flowering. Burr production per unit area is high. Burrs are of intermediate size and have a mainly distal distribution. Burr burial is good. Seed colour is black. Approximately 156 000 seeds per kg.

Agronomic characters

Goulburn is of late-midseason maturity. In Perth, it begins flowering 8 days later than Mt Barker and 13 days later than Woogenellup. However, in cooler districts of Western Australia and in New South Wales, flowering generally starts between the dates of Mt Barker and Woogenellup. Fresh leaves of Goulburn contain a trace of formononetin (<0.05% of dry matter) with 0.7% d.m. and 0.3% d.m. of genistein and biochanin A, respectively. Goulburn is more hard-seeded than other cultivars in its maturity class. In three laboratory tests, Goulburn averaged 29.7% hard-seed after 4 months in an alternating 60 °/15 °C temperature cabinet, compared to Junee, Green Range, Karridale, Mt Barker and Woogenellup with 31.7%, 22.7%, 8.7%, 3.0% and 3.0%, respectively. These relative differences have been confirmed by field ratings. Goulburn is compatible with commercial strains of *Rhizobium trifolii* (R. Roughley, pers. comm.).

Goulburn has a high level of resistance to clover scorch, *Kabatiella caulivora* (Kirch.) Karak. In field screening trials conducted over seven years, Goulburn has had an average rating of 2.9, compared to Green Range, Karridale, Mt Barker, Woogenellup and Esperance with 3.1, 4.6, 5.5, 7.0 and 1.0, respectively (increasing damage scale of 0–10). Goulburn has a high level of resistance to root rot caused by *Phytophthora clandestina* Taylor, Pascoe and Greenhalgh. Greenhouse tests, using an increasing damage scale of 0–1.0 gave a rating for Goulburn of 0.07, compared to Karridale, Larisa, Mt Barker, Green Range and Woogenellup of 0.2, 0.0, 0.7, 0.8 and 1.0, respectively. Goulburn appears to have a higher level of tolerance to root rot caused by *Pythium irregulare* Buisman than current late-midseason cultivars. In a phytotron study, 5 week-old seedlings of Goulburn had an average plant weight, as a proportion of uninoculated controls, of 55%, compared to Karridale, Woogenellup and Mt Barker with 40%, 46% and 31% respectively.

Goulburn has greater resistance to leaf rust, *Uromyces trifolii-repentis* Liro, than Mt Barker and much greater resistance than Karridale and Green Range (Barbetti and Nichols 1991a). It is also similar to Woogenellup and superior to Karridale and Green Range for resistance to powdery mildew (*Erysiphe polygonii* D.C.) (Barbetti and Nichols 1991b). Goulburn has moderate resistance to leafspot caused by *Cercospora zebrina* Pass. In a field trial, Goulburn was found to have a leafspot severity rating not significantly different from Woogenellup and Green Range, but significantly less than Mt Barker and Karridale. On the basis of field ratings from Holbrook, New South Wales, Goulburn appears susceptible to common leafspot, *Pseudopeziza trifolii* (Fr.) Fuckell.

Field ratings from Hobart, Tasmania, of visual symptom development following virus inoculation, indicate that Goulburn develops slight symptoms to Alfalfa Mosaic and Clover Yellow Vein viruses, mild symptoms to Bean Yellow Mosaic and Subterranean Clover Red Leaf viruses, moderate symptoms to Cucumber Mosaic Virus and strong symptoms to Beet Western Yellows Virus. Field reaction to Subterranean Clover Mottle Virus has been recorded as mild in Tasmania but severe in Western Australia (J. Wroth, pers. comm.). Goulburn is susceptible to Subterranean Clover Stunt Virus (P. Chu, pers. comm.).

Goulburn is similar to Karridale, Green Range and Woogenellup for susceptibility to red-legged earth mite (*Halotydeus destructor* Tucker) at the seedling stage. A phytotron seedling study gave damage ratings of 5.2 for Goulburn, compared to 5.4 for Karridale and Green Range, 6.0 for Woogenellup, and 4.2 for Mt Barker (increasing damage scale of 0–10). At the adult stage, Goulburn suffers visible damage similar to that of Woogenellup, but much less than that of Green Range. Goulburn has a similar level of blue-green aphid (*Acyrthosiphon kondoi* Shinji) tolerance to Karridale. In a glasshouse trial, adult plants of Goulburn infested with blue-green aphids weighed 38% of uninfested controls, compared with Karridale, Clare, Daliak and Junee with 41%, 61%, 35% and 30%, respectively.

Goulburn has been selected as an alternative to Woogenellup for the medium and high rain-

fall zones of New South Wales and Western Australia where cv. Woogenellup has previously been sown. In Western Australia, it has also been selected as a leaf rust-resistant and Phytophthora root rot-resistant replacement for cv. Green Range. Winter and spring herbage production of Goulburn has generally exceeded that of Woogenellup in New South Wales and Western Australia, and has at least equalled that of Green Range in Western Australia. The production advantage of Goulburn over Woogenellup is even more marked in the presence of clover scorch or Phytopthora root rot diseases. At Manjimup, Western Australia, spring clover production of Goulburn averaged 253% higher than that of Woogenellup in 1988 and 1989, following significant outbreaks of clover scorch.

In spite of its slightly later maturity, the seed production of Goulburn in medium to high rainfall areas of New South Wales has been similar to that of Woogenellup. It has also consistently produced and maintained higher seed populations than Woogenellup and Green Range in Western Australia. In trials in both States, Goulburn has produced higher seedling populations than Woogenellup and Green Range and maintained higher plant densities throughout the growing season. The greater hard-seededness of Goulburn offers the additional advantage over Woogenellup of greater long-term persistence, by ensuring more reliable regeneration in seasons following either a poor seed-setting season or a year in crop.

Goulburn should be more reliable for haymaking than both Woogenellup, due to its superior clover scorch resistance, and Green Range, due to its superior rust resistance. Goulburn will also be a suitable replacement for Woogenellup in poorly drained and irrigation areas of New South Wales, due to its high level of resistance to Phytopthora root rot.

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