

Gland clover- a new insect resistant legume

B. S. Dear^A, G. A. Sandral^A, B. Nutt^B, B. Wilson^A, C. Rodham^A, and J. Taylor^A

^ANSW Agriculture, Agricultural Institute, Wagga Wagga, NSW 2650

^BAgriculture Western Australia, Baron Hay Court, South Perth, WA

Abstract

Gland clover is a new small seeded annual pasture legume due for commercial release in 2002. The major advantage of this legume is a very high level of resistance to red-legged earth mites (RLEM) and aphids. It is also very resistant to clover scorch disease. It can be grown either in a mixture with other annual legumes or lucerne or as a pure sward.

Description

Gland clover (*Trifolium glanduliferum* Boiss.) is a semi erect annual legume native to the Mediterranean region of Europe and has not been previously commercialised. It grows from autumn through to late spring and is suitable for pasture sowings in southern Australia. The first cultivar selected called Prima, is an early maturing type flowering 100-115 days after a mid May sowing. Flowers are pink, deepening in colour with age. Leaflets are smooth, trifoliate, round in shape when young, becoming elongated in mature plants. Stems are green and smooth but can display some reddening on the upper surface. It grows to a height of 40–50 cm in spring.

Origin

Only 2 lines of *T. glanduliferum* (CPI 87182 and CPI 87181) were held by the Australian Trifolium Genetic Resource Centre (ATGRC) in 1993 and these formed the basis of the initial evaluation in 1994 by the Centre for Legumes in Mediterranean Agriculture (CLIMA) and Agriculture Western Australia. Subsequent field evaluation of *T. glanduliferum* was undertaken through the National Annual Pasture Legume Improvement Program (NAPLIP). The cultivar Prima was selected from breeding line CPI87182 originally collected by J. S. Katznelson in 1976 in the Yehudiyya Forest, Golan, Israel. Some field selection was undertaken to remove genotypes with a laciniate leaf. The ATGRC now holds 26 accessions of *T. glanduliferum* with the collection varying in flower colour, leaf shape and insect tolerance.

Adaptation

Gland clover is adapted to a wide range of soil types having being grown on neutral to mildly acid soils ranging from well drained to those experiencing mild waterlogging. It has not performed well on deep sandy soils. In southern NSW it has been successfully grown in areas receiving between 375 and 600 mm annual rainfall.

Insect and disease tolerance

Based on glasshouse screening and field observations Gland clover has proven to be very resistant to insect pests having a high level of tolerance to RLEM, blue-green aphids and cow pea aphids. However it is susceptible to lucerne flea. Prima is not susceptible to clover scorch disease. Limited field observations suggest that including gland clover in mixtures with other legumes can reduce the numbers of RLEM in the pasture but this needs to be confirmed.

Productivity

Prima gland clover has been very productive in the first year with good regeneration in second and third years. Production figures indicate it has similar herbage yields to Frontier balansa clover. Where sown as part of a mixture it will form a valuable part of the sward especially where insect pressure is high. Because of its very small seed size it will not be competitive against vigorous seedlings of other plants in autumn. Close grazing in autumn to reduce shading by other species will be important to ensure good persistence as is the case for all small seeded legumes (eg. balansa clover). It persists well in pure swards but experience has

shown that it does not persist as well with late or heavy grazing at flowering. Hence Prima gland clover should only be grazed lightly during flowering to ensure a good seed set. In experimental sowings, Prima has spread up to 2m over 3 years from its original location. Further work is required to determine optimum grazing management practises to ensure its persistence in mixed swards.

Seed

Seed size is very small at about 0.7 mg/seed, yellow and oval in shape. Approximately 40-50% of seed is hard at the beginning of the following growing season (i.e. April / May). This level of hard seed ensures an adequate protection of seed to guard against false breaks. Due to the small seed size most seed ingested by stock is expected to pass through the rumen undigested.

Harvestability

Seed of gland clover is readily harvested with conventional machinery due mainly to its upright growth habit in spring and flowers that are held at the top of stems. Seed yields at a number of sites have ranged from 300-1000 kg/ha. The variety Prima must be harvested with a conventional header as the seeds shatter readily with disturbance and are too small to be suction harvested. Seed harvested on farm must be scarified prior to sowing to increase germination percentage. Prima will be produced and marketed only under a contract system. This does not restrict production for personal use. Propagation of seed for sale can only be carried out by agreement with a contracted licensee. Prima will be subject to a pedigree seed certification scheme.

Sowing

Seed should be sown no deeper than 5-10 mm into a well prepared seed bed in autumn. Sowing rates of 2-4 kg/ha are recommended, the lower rates being used when sown in mixtures with other legumes. A sowing rate of 5-8 kg/ha should be used for seed crops. Seed should be inoculated with Group C inoculant. Gland clover can be expected to have similar nutritional requirements as other clovers.

Chemical basis of insect tolerance

Analysis of extracts from gland clover indicate that it contains coumarins which are thought to convey the high level of insect tolerance. At high levels these chemicals have caused health problems in cattle in North America when fed hay made from sweet clover (*Melilotus* spp). The problem arises when hay cut from pasture containing coumarins is allowed to go mouldy and then fed to livestock. The coumarin is converted to dicoumarol, which has anti-blood clotting properties.

As this is the first time this species has been commercialised, additional studies have been conducted in Western Australia to address duty of care concerns about the presence of coumarins. These included feeding studies with sheep and the effect of stresses on coumarin levels. The results of these tests found that coumarin levels in 11 different lines of gland clover ranged from 13 to 90 ug/g (ppm) in fresh leaves. The levels found in green leaves of the cultivar Prima were lower (15 to 40 ppm) than critical values considered to cause problems with blood clotting. Analysis of 4 hay samples made from Prima and subject to artificial spoilage, found that only 1 sample contained a very low level of dicoumarol (3.8-6.3 ug/g of hay), no dicoumarol was detected in the other 3 hay samples.

Studies of sheep fed on green herbage and dry residues of Prima gland clover have shown no ill health effects and similar liveweight gains have been achieved for those sheep fed on sub clover. Similarly, taste tests of meat from sheep fed on gland clover could not detect any abnormal flavours. Pigs are more sensitive to dicoumarol than sheep and cattle and feed should contain less than 0.4 ug/g dicoumerol per kg bodyweight. Normal precautions suggest that gland clover should not be ingested by humans.

Acknowledgments

Prima gland clover was initially selected by Brad Nutt from CLIMA and later evaluated by NAPLIP. Background data on the origin and selection of Prima were kindly provided by Brad Nutt, Angelo Loi and Mike Ewing from CLIMA and Agriculture WA.