

Assessment of *Lotus tenuis* for desirable seed production characteristics

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Abstract

Lotus tenuis, narrow-leaf birdsfoot trefoil, is a temperate perennial forage plant recognised for its salinity and waterlogging tolerance. Current demand and usage of *L. tenuis* in Australia and other parts of the world, particularly South America, are limited by the availability of suitable cultivars with seed production characteristics that facilitate reliable yields and harvestable quantities of seed. Ninety eight accessions/cultivars of *L. tenuis* were assessed under field conditions at two sites in Tasmania for a range of characteristics including: plant growth habit, seasonal herbage activity/production, plant width and height at flowering, pod shattering, and seed yield. From these results plant selections were made based on low pod shattering ratings and overall growth performance. The future aim is to produce several new cultivars that have a combination of desirable agronomic and seed production characteristics with potential for use in pastures in Australia, particularly where salinity and waterlogging are a common problem.

Key Words

Perennial legumes, pasture, salinity, waterlogging

Introduction

Lotus tenuis Waldst. & Kit. ex Willd., narrow-leaf birdsfoot trefoil, is a herbaceous perennial forage species of Mediterranean origin that is adapted to low fertility, waterlogged, and saline soils, and is cultivated primarily in New Zealand, Europe and the Americas (Dear *et al.* 2003). Although similar to *L. corniculatus*, its ability to exclude Na and Cl from the xylem enables *L. tenuis* to better tolerate the combined abiotic stresses of salinity and waterlogging (Teakle *et al.* 2006). As a result it is naturalised and widespread in the flood-prone and salinity affected Pampa region of Argentina (Buenos Aires Province) (Vignolio *et al.* 2011). In addition to producing forage of high nutritional value and palatability, the cultivation of *L. tenuis* has been used to reduce soil erosion and the spread of dryland salinity in New Zealand (Schachtman & Kelman 1991).

The widespread use of *L. tenuis* as an alternative forage species for inclusion in sown pastures or as a specialist plant for preserving or rehabilitating land affected by salinity and waterlogging has been limited by the availability of suitable cultivars and reliable quantities of certified seed on the global market (Vignolio *et al.* 2010). In Australia, the potential for including this species in areas affected by salinity and waterlogging is significant as the impact of salinity continues to expand and commonly sown species such as *Trifolium repens* L. (white clover) and *Medicago sativa* L. (lucerne) fail to perform in these situations.

Lotus tenuis is recognised as being difficult to grow as a seed crop due to climatic restrictions, indeterminate flowering, pollination management, weed control, and pod shattering. Tasmania was identified as a suitable location to evaluate a wide range of accessions of *L. tenuis* due to the

favourable temperate climate, requirement for 12-14 hour daylengths to initiate flowering and the presence of an established specialised pasture seeds industry.

The aim of this research was to characterise a wide range of accessions of *L. tenuis* and assess seed production under field conditions in Tasmania.

Methods

Ninety one accessions and seven cultivars of *L. tenuis* were assembled from germplasm collections held by the Tasmanian Institute of Agriculture, Margo Forde Forage Germplasm Centre and United States Department of Agriculture. Seed of each accession/cultivar was germinated on moistened pads in December 2009 and pricked into 64 cell Yates Rite-Gro Kwik trays and grown in glasshouse conditions under natural light. The seedlings were inoculated with rhizobia (SU 343) at 3 weeks. In Autumn 2010 the plants were transplanted into two field sites, one in northern Tasmania at Launceston (longitude 147°E, latitude 41°S and annual rainfall 670 mm) and one in southern Tasmania at Cambridge (longitude 147°E, latitude 43°S, and annual rainfall 490 mm). The two sites were established using weed matting with single rows of 20 plants for each accession/cultivar and watered as required through to maturity.

Data on vegetative growth and plant development were collected from both sites on a seasonal basis in 2010 and 2011. A wide range of plant characteristics were recorded but only the following are included here: plant height and width at time of flowering (cm); summer growth ratings (0-9 best); pod shattering and seed yield. Pod shattering (0= none – 10= all) and seed yield were collected from the Launceston site only.

Data were analysed using principle component analysis with the application Minitab.

Results

Plant height and width at flowering

Comparisons of plant height and width at flowering (Figure 1) showed that a large number of accessions have a growth habit and size considered desirable for forage production and ease of seed harvesting, (width > 100 cm and height >20 cm) when grown as individual spaced plants. A significant number of these accessions were relatively similar in growth performance and habit to the seven cultivars included in the experiment.

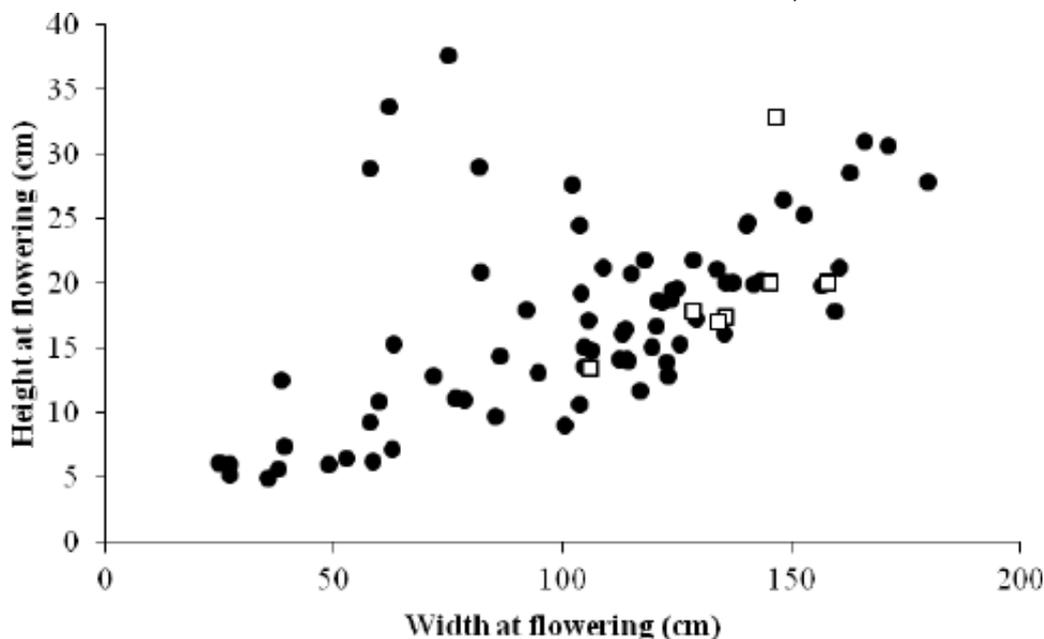


Figure 1. Plant size of accessions/cultivars of *L. tenuis* at flowering, based on individual plant measurements for height and width (cm). Accessions are represented by (●) and existing cultivars by (□).

Pod shattering and seed yield

Pod shattering ratings were determined on the best two plants selected from each accession. All information collected was used in determining the “best plants” i.e. growth ratings, plant size at flowering and an initial indication the plant was holding its pods. The individual plants were cut when the first formed pods for that plant showed signs of shattering and dried for two weeks at 40⁰ C.

Plants were then rated for pod shattering, (10 = 100% of pods shattered, 1 = 10% of pods shattered). The seed yield plotted against a pod shattering rating for the more promising accessions (Figure 2) indicated that there were accessions that had an acceptable level of pod shattering, but also high seed yield on a per plant basis. Pod shattering ratings for the seven commercial cultivars ranged from 6 through to 10 (mean 8.6), highlighting the issue with existing cultivars and potential for improvement based on the accessions examined.

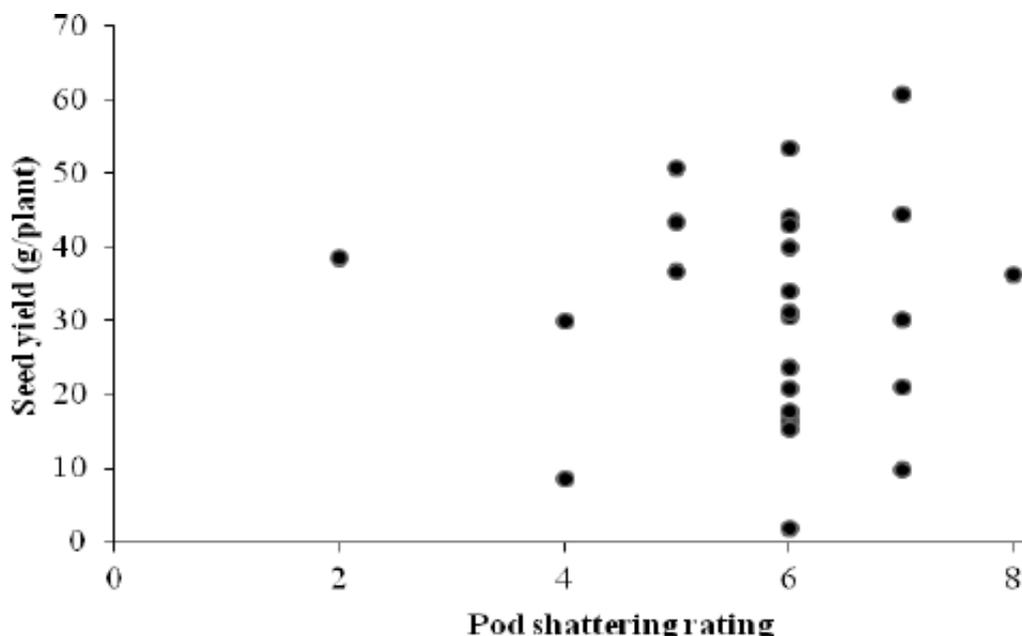


Figure 2. Seed yield (g/plant) and pod shattering rating (0= none, 10= all) for selected

accessions of *L. tenuis*.

Summer growth and pod shattering

There was a relatively good association between summer growth rating and pod shattering rating for the best performed accessions of *L. tenuis* (Figure 3). The accessions that warrant further investigation were therefore those that had a high summer rating and low pod shattering rating.

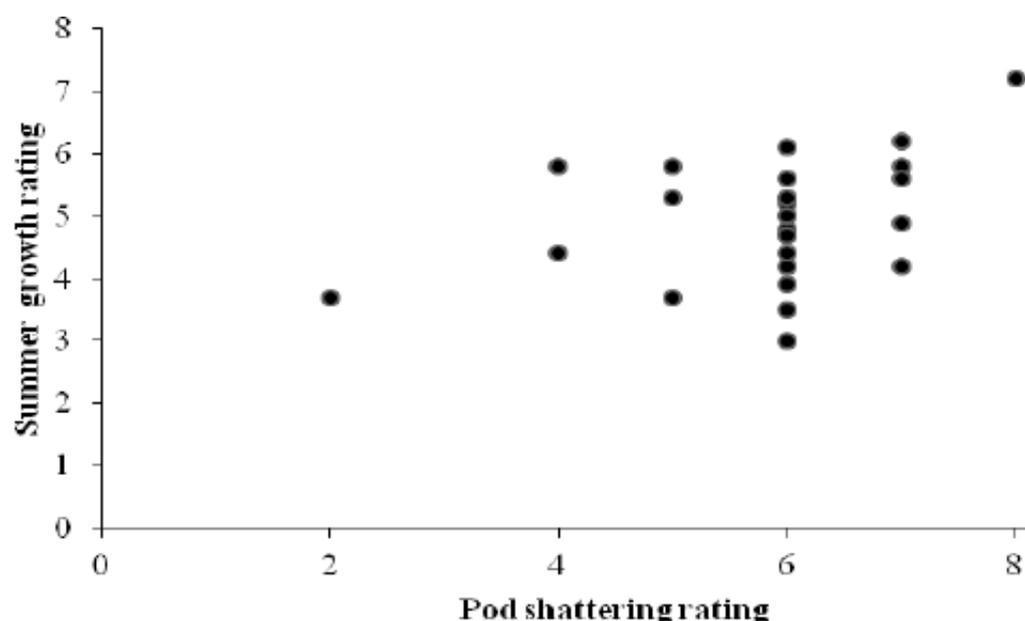


Figure 3. Summer growth rating (0 - 9, best) and pod shattering rating (0= none, 10= all) for selected accessions of *L. tenuis*.

Conclusion

Results from this study indicated that a number of *L. tenuis* accessions possessed seasonal growth and seed production characteristics required for selecting plant lines for development of new cultivars. There is good evidence that plants have been identified that largely overcome previous limitations of pod shattering, a key feature that has restricted the production of viable quantities of seed of *L. tenuis*. Further work is required based on the selected accessions for the development of cultivars for seed production in Tasmania. With production of adequate quantities of commercial seed there is good potential for more widespread use of *L. tenuis* as an alternative forage legume in pastures, generally, and more specifically in environments where salinity and waterlogging are a common problem.

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