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Effect of legume growth form on compatibility of grass-legume pasture mixtures

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Survival of 67 climatically adapted tropical legume accessions, representing a range of species and growth forms, was evaluated in bahiagrass pastures at Ona, Florida. Only *Vigna parkeri cv.* Shaw persisted for more than four years under continuous grazing at a moderate stocking rate. Three species, *Desmodium barbatum, Desmodium heterocarpon cv.* Florida, and *Alysicarpus vaginalis*, survived three years of grazing. These four persistent species survived as prostrate, perennial plants similar in growth form to the grazed grass canopy. Several up-right and climbing accessions survived under limited grazing, and some re-established themselves after continuous grazing was terminated. Growth form appears to be the major determinant of grazing tolerance of climatically and edaphically adapted legumes in peninsular Florida. Identification of compatible growth forms of grasses and legumes and determination of specific management techniques to enhance compatibility of less-suitable plant combinations could improve the generally poor results from introducing tropical legumes into grass pastures.

Keywords: Bahiagrass-legume pastures; Grazing tolerance; Growth forms

Introduction

Tropical legume germplasm represents a diverse and extensive gene pool for development of high quality, nitrogen-fixing pasture plants. This potential has been recognized and evaluated widely with only a very limited development of successful pasture cultivars. Although only a portion of this tropical legume germplasm is held in germplasm collections, even these available collections represent tremendous quantities of plant material. Various methods are currently used to select representative species and/or accessions from similar locations or geographic regions to reduce the volume of accessions for initial screening. However, even when climatically adapted germplasm has been identified and evaluated in spaced plantings, individual rows, and field plots, development of commercially successful pasture cultivars has not generally followed.

A more critical appraisal of materials to be evaluated and modification of the classical approaches to forage plant germplasm evaluation appear to be in order at many tropical locations where resources for plant evaluation are limited and some urgency in pasture development exists. In 1978, Tothill pointed out that growth form is important in the combination and management of pasture plants. He emphasized the need for a sufficient number of growing points to remain intact following grazing for growth and production to continue. Also noted as advantageous for forage plants were such growth forms as prostrate tendencies, sward formation, and stolon and/or rhizome production.

Tolerance of heavy grazing has been reported for tropical legumes such as *Lotononis bainesii* (Bryan and Evans, 1973) and *Vigna parkeri* (Jones, 1984). Tolerance of grazing by these palatable legumes is associated with their low growth form. Persistence and even sward dominance under high stocking rates have been obtained with unpalatable legumes such as *Calopogonium mucunoides* (Lascano, 1987). However, this legume persistence under heavy stocking is the result of lack of grazing rather than tolerance of grazing. Legumes which persist due to lack of acceptability to grazing livestock will provide little benefit to animal protein needs and may be of limited value in pasture situations.

Evaluation of grazing tolerance at Ona, Florida

Over thirty species of climatically-adapted tropical legumes have been evaluated for persistence under grazing as replicated single-row plants in bahiagrass (*Paspalum notatum*) pastures on a spodosol site at Ona, Florida from 1981 to 1986. Major plant adaptive traits required for survival in this environment include tolerance of periodic summer waterlogging, mild winter frost, spring dry periods, and mildly-acid soils. Genera represented include *Aeschynomene, Arachis, Alysicarpus, Centrosema, Desmanthus, Desmodium, Galactia, Lotononis, Macroptilium, Neonotonia, Stylosanthes, Teramnus, Vigna* and *Zornia*. Growth forms ranged from the upright growing *Aeschynomene* and *Stylosanthes* species to the twining growth of *Centrosema, Macroptilium atropurpureum*, and *Vigna luteola*.

Light stocking rates and/or rotational grazing resulted in the persistence of a number of accessions including *Macroptilium atropurpureum* and *Vigna adenantha*. However, continuous grazing at moderate stocking rates resulted in persistence of only the prostrate-growing *Vigna parkeri* after four years of grazing. Removal of cattle after one or two growing seasons resulted in gradual re-establishment of the twining legumes *M. atropurpureum, Centrosema virginianum, Vigna adenantha* and *V. luteola*. Since these evaluations were single-row plantings, the suggestion of Tothill (1978) that a threshold level or critical population size may be necessary for an adapted genotype to establish and persist should be acknowledged.

While appropriate pasture management could result in effective use of some of the upright and/or viny legumes, the prevailing pasture management in peninsular Florida of heavy stocking rates and continuous grazing on bahiagrass pastures appears to be compatible primarily with legumes having growth forms similar to bahiagrass. Although other low-growing species did not persist as well as *Vigna parkeri* in this evaluation, a perennial *Alysicarpus vaginalis* accession, a perennial seed-propagated *Arachis* accession, *Desmodium barbatum, Desmodium heterocarpon*, and *Zornia latifolia* also persisted through at least two years of grazing in peninsular Florida bahiagrass pastures at this or other sites. The accessions of *Arachis* and *Zornia* are apparently adapted primarily to the better drained sites.

One-half hectare pastures of the three *Vigna* species, *V. adenantha, V. luteola* and *V. parkeri*, have been planted, allowed to become well established, and then grazed continuously during the summer period each year. *V. luteola*, which has a twining-climbing growth habit, failed to persist through the first grazing period. *V. adenantha*, which is a climbing legume that roots at the nodes more effectively than *V. luteola* or Siratro (*Macroptilium atropurpureum*), decreased during the grazing period. However, grazing was terminated approximately two months before frost each year, and *V. adenantha*

regrowth dominated the pastures by the time the frosts occurred. *V. parkeri* gradually spread under continuous grazing and has confirmed the conclusion from the single-row plantings that this legume is tolerant of this grazing management in bahiagrass pastures.

Discussion

While the experiences from a single location hardly justify universal recommendations, the extensive tropical legume evaluation programme in Australia provides at least a degree of concurrence. As stated by Jones and Jones (1978), the extensively planted tropical legume cultivar, Siratro, does not generally persist under heavy defoliation because of its twining, indeterminate growth habit, small number of growing points near ground level, and slow regrowth of the existing growing points. Cook and Jones (1987) noted a greater emphasis on grazing persistence in recent years as a result of the failure of the twining pasture legumes, even with their greater potential dry matter yields, to persist under 'constant or regular' grazing. Shaw Creeping Vigna (*Vigna parkeri*) is the first cultivar developed from this effort.

The relationship of legume growth form to sward stability and persistence under grazing obviously differs tremendously for different situations. With the unpalatable legumes generally adapted to the drier tropics, legume dominance can be the major constraint to grass-legume pastures, where frequent or continuous grazing may favour the less-competitive legumes grown with grasses of greater palatability (Lascano, 1987). Thus, the need for compatible growth forms and acceptable relative palatabilities. Suitable management procedures must be defined for the various pasture situations. Once these conditions are defined, identification of legume germplasm with the desired growth form and palatability should take precedence over such traditional forage plant evaluations as yield and forage digestibility determinations. Thus, preliminary evaluations of the response of tropical legume germplasm to grazing should be included early in the evaluation programme. In fact, dry matter yield under clipping regimes may often be of little value since there will probably not be a large number of persistent legumes to select between for high yield.

Of the legumes available and adapted to various areas of the Caribbean, potential for sustained contributions to livestock grazing appears to be greatest under current management for species such as *Teramnus labialis*. Paterson et al. (1986) noted that this legume is best suited to neutral or alkaline sites and is not as productive as some other species; thus, they recommend that it be planted at a light seeding rate as part of a legume mixture. This strategy should be considered more widely as grazing tolerant species are identified. When circumstances permit, management for the more productive legumes could be beneficial at least initially, and long-term pasture improvement could be realized from the persistent legume component. Emphasis should be placed on identification and commercial development of such persistent legumes, with less investment in labour intensive plot evaluations of legume yield under conditions not representative of the most-likely future grazing situation.

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