RESULTS AND DISCUSSION

Within each collecting year

In the CY 1988, during the first, second to third softening season (SS) a similar pattern of germination of soil surface seeds was observed, with a significant increase (P<0.05) at the end of March. From the beginning of each growing season (autumn=May) till the end of January, no significant softening occurred in any of the 3 SS (Fig. 1).

At the end of each SS (March) buried seeds had a significantly higher germination than surface soil seeds (Fig. 1).

Within softening season

The performance of surface soil seeds germination during the first SS depended on the CY.

For the CY 1988, the germination in March significantly increased (P<0.05), compared with previous months. In contrast, for 1989 and 1990, in January and March the germination was significantly higher (P<0.05) than the former months, especially in the CY 1990 (Fig. 2).

Also, there were significant differences (P<0.05) between each CY at the same month (Fig. 2). For example, from May to September the germination was similar in 1989 and 1990 but lower than those of CY 1988. In January and March the germination was similar in CY 1988 and 1989, but both significantly lower than those of 1990.

For the second SS the germination pattern was similar for the 2 collecting years analysed. The mean was 25.9, 28.1, 25.1, 26.9, 31.9 and 44.1% for May, July, September, November, January and March respectively, only the 44.1% figure being significantly higher than the remainders (P<0.05).

Data of surface soil temperatures (at a depth of 5 cm) are available only since July 1990, so it is not possible to explain the differences observed between CY during the first SS. From November 1990 to March 1991 the differences between the maximum and minimum temperatures cited above were higher than 20°C, minimum and maximum temperatures ranging between 5.1°C and 8.2°C and 27.5 and 29.7°C respectively, for the same months, when significant softening occurred in this CY (1990).

Figure 1 Seed germination (%) on soil surface (---) and buried to 1-2 cm (*) during the first, second and third softening season (SS), in the collecting year 1988 (a)

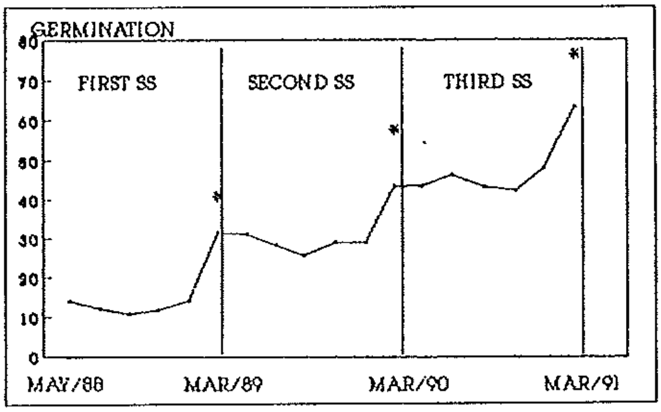
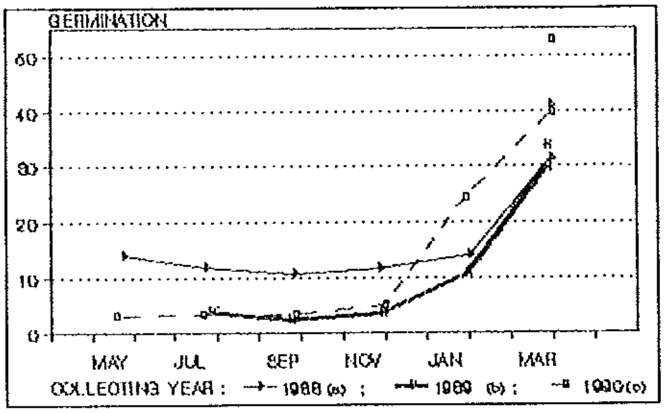


Figure 2 Seed germination (%) on soil surface and buried during the first softening season in 3 different collecting years



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A legume ley system in Australia's semi-arid tropics

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ABSTRACT

A large part of the Australian continent is semi-arid and tropical. While extensive beef cattle grazing is the most significant agricultural industry in this region, there is some potential for dryland cropping. There are strong economic and ecological reasons for exploring the possibility of a no-till tropical ley system. Work at Katherine, Northern Territory, found that a ley system based on *Stylosanthes hamata* cv. Verano showed considerable promise based on both contributions to dry-season animal performance and nitrogen contribution to succeeding coarse grain crops. Subsequent research and development in the wetter Douglas-Daly district of the Northern Territory has demonstrated even greater benefits using the legume *Centrosema pascuorum*. A number of farmers have adopted this system, and commercial performance over 2 years has been promising.

KEYWORDS: Australia, legume ley, semi-arid tropics

INTRODUCTION

The "Top End" of the Northern Territory usually receives 800-1800 mm of rain a year, almost all of which falls during a summer growing season of 4-5 months. Extensive grazing of natural pastures is the prevalent land use. Within this region there are areas of soils suitable for cropping, and much research and development since the end of World War II has been directed at developing a cropping industry. While several ambitious schemes aimed at export have failed, there is a limited, stable, local market for feed grains. This paper concerns a system for supplying this market in conjunction with beef production.

METHODS

In 1978 research began to test a system of cropping with the following features:

- a self-regenerating legume ley pasture of 1-3 years' duration grown in rotation with maize or sorghum
- cattle graze native grass pastures during the green season and leys plus crop residues in the dry season
- crops are planted directly into the pasture which is chemically killed shortly before planting
- the pasture legume sward which volunteers from hard seed is allowed to form an understorey in the crop
- after 1 year of cropping, pasture is allowed to regenerate

This system was methodically tested at Katherine, N.T. (mean annual rainfall 950 mm, Fig. 1) comparing 3 legumes, *Centrosema pascuorum*, *Stylosanthes hamata* cv. Verano, and *Alysicarpus vaginalis*. Average (3 yrs) annual live-weight gains of steers on native pasture in the growing season and in cropping lands in the dry season were 123 kg/head compared with 93 kg for steers on native pasture continuously (Fig. 2). There were no significant differences between the effects of legume species on animal production. The most persistent legume at Katherine was the stylo. Legumes regenerated readily under the grain crop, and produced from 0.3 to 4.0 t/ha dry matter depending on canopy density of the crop and amount of rain toward the end of the season. *Centrosema* was much later flowering than the other legumes and best utilised residual soil water after maize maturity and senescence. The nitrogen contribution of a legume ley was mostly between 40 and 70 kg but ranged from 10 to 90 kg of fertiliser N equivalent (Jones et al. 1991). Presence of the legume even under conditions of high fertiliser N and good water supply always reduced grain yields slightly. When either N or water was scarce, competition was much more severe. Simulation studies show that serious grain yield reduction due to water competition can be expected in 1 year out of 10 (Carberry, in press) (Fig. 3).

In the Douglas-Daly district (mean annual rainfall 1200 mm, Fig. 1), in a government-sponsored project, farms were exclusively cereal and grain legume cropping enterprises. As land became freehold, farmer preference for grain production in conjunction with beef cattle grazing stimulated research into legume ley farming and provided an

Figure 1 Mean weekly rainfall for Katherine and Douglas Daly

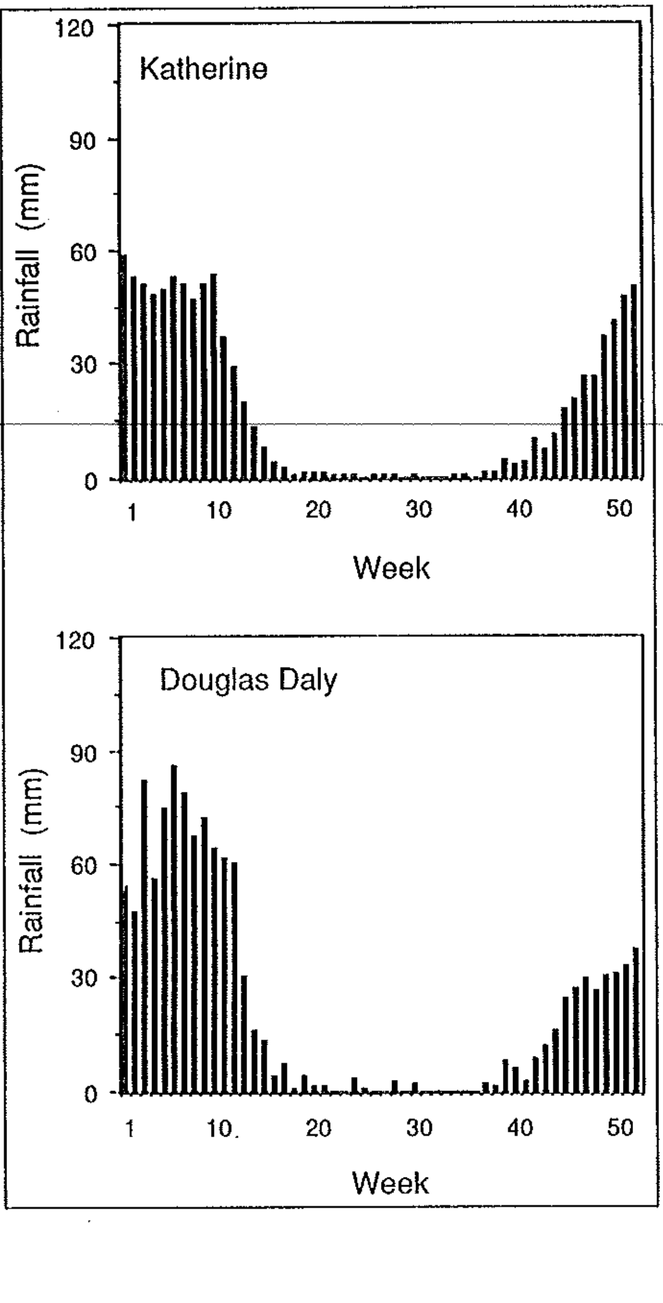


Figure 2 Cumulative live-weight trends for cattle either continuously on native grass pasture (thin lines) or on croplands (thick lines) in the main dry season and on natural grass pasture for the rest of the year. (Redrawn from McCown et al. 1986)

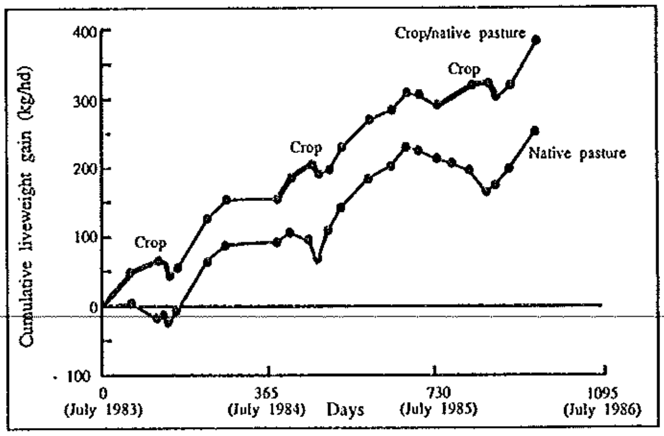
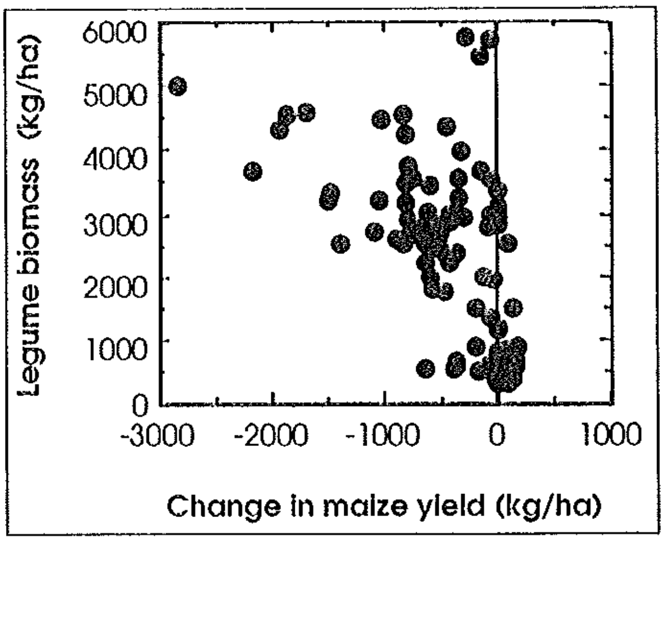


Figure 3 Understorey legume biomass production versus the corresponding changes in the grain yield of intercropped maize simulated for 100 seasons at Katherine, N.T



opportunity for R & D under commercial conditions. During the 1980s the high production potential of *Centrosema pascuorum* cv. Cavalcade and cv. Bundy became apparent. Beginning in 1989, 2 consecutive crops of grain sorghum planted after Cavalcade centro were unresponsive to N fertiliser and yields at nil N were 4.5 and 3.5 t/ha (Thiagalingam et al. 1991). This experiment showed that 2 years of Cavalcade can provide 80-120 kg/ha N to a sorghum crop with a saving of $70 in fertiliser costs. Only 2 l/ha Roundup were needed to kill the ley and provided effective weed control. The no-till crop was better able to tolerate prolonged dry spells. Legume regeneration was good in both seasons, and legume presence did not appear to compete with the sorghum crop. Although no live-weight data are available, the main attraction of this system to local farmers is the high performance of cattle on the ley pastures.

RESULTS AND DISCUSSION

Farmers in the Douglas-Daly cropping scheme who have diversified into cattle have adopted, or are in the process of adopting, a crop-pasture rotation combined with no-till techniques. A *Centrosema pascuorum* cultivar is sown through the sorghum seed box in the sorghum row. After a crop of sorghum, the ensuing legume sward from seed set by the "intercrop" is used for grazing, hay, or seed production for 2 or 3 years. A no-till sorghum crop can be grown with little or no N fertiliser.

Based on the experience of a number of farmers during the past 3 years, a grain-pasture legume rotation system appears to be commercially adaptive in this situation where there are financial benefits from the legume in both the crop and animal enterprises. In a region where R & D expectations have rarely been fulfilled commercially, in this case research and extension may have provided the right technology at the right time.

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