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TEMPERATURE CONSTRAINTS TO SOWING TIME OF LEUCAENA IN SOUTHEAST QUEENSLAND

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ABSTRACT

*The relative growth rate (RGR) of establishing leucaena (*Leucaena leucocephala *cv. Peru) sown at different times in spring and summer was studied. Early growth was best related to minimum air temperature which accounted for 74% of the variation in RGR. Maximum air temperature and solar radiation had little influence on RGR. The results indicate that leucaena should be planted when the mean daily minimum air temperature is likely to be above 15°C.*

INTRODUCTION

Leucaena (*Leucaena leucocephala*) is a forage shrub from central America (Hill 1971), and is a useful fodder plant for cattle production in the sub-humid subtropics.

Leucaena may be sown from early spring to late summer depending on land preparation, potential weed problems, rainfall, and temperature. Early spring sowing is desirable as it produces seedlings of sufficient size to tolerate mechanical weed control in the first summer and frosts in the winter (Cooksley 1982). However, leucaena is slow to establish, and low temperatures, if sown too early in the spring, may suppress seedling growth (Hutton and Gray 1959). The critical minimum daily maximum or daily minimum temperature below which seedling growth is too slow to obtain reliable establishment has not been adequately defined.

This paper examines the establishment of leucaena in a number of experiments at "Brian Pastures" in southeast Queensland and explores the relationship between the growth rate of leucaena seedlings in the establishment phase and several associated climatic variables.

METHOD

Ten plantings during spring and early summer from 1971 to 1975 were conducted at "Brian Pastures" Pasture Research Station Gayndah (25°39′S, 151°47′E, Alt. 130 m, average annual rainfall 735 mm) on a basalt derived soil Ug 5.13 (Northcote 1971).

Leucaena seed (cv. Peru) was heat treated and soaked for two days to increase percentage and rate of germination (Cooksley 1979). It was sown at a depth of 5 cm (Cooksley 1982) either before or after irrigation, while rain fell during all trials. Soil moisture and nutrients were adequate for growth following all plantings and the plots were frequently hand weeded.

For each sowing, between 15 to 55 seedlings were harvested at ground level, dried at 70 °C for 48 h, and mean relative growth rate of tops (RGR) calculated using the formula:

$$RGR = (\ln W_2 - \ln W_1)/t,$$

where W_1 and W_2 = dry weight of tops at emergence and final harvest, respectively, and t = number of days from emergence to harvest.

Mean cotyledon weight at emergence (11 mg plant^{-1}) was measured in one experiment and taken as representative of W_1 for all plantings which were from samples of similar sized seeds.

Linear, quadratic and multiple regression analyses were conducted for RGR on the average values over each growth period of daily minimum, maximum and mean ((min. + max.)/2) air temperatures and solar radiation.

RESULTS

Planting dates, days to emergence and harvest, RGR, solar radiation, average daily minimum, maximum and mean air temperatures are presented for nine plantings (Table 1). The tenth planting on 4 September 1972 emerged poorly and there were insufficient seedlings to reliably estimate RGR. Therefore, this planting was excluded from the statistical analysis, although it emphasised the disadvantages of sowing too early—the mean minimum temperature for September was 10.6 °C.

The RGR of the leucaena seedlings was most closely related ($P < 0.05$) to mean minimum daily air temperature (T_m), which accounted for 74% of the variation in RGR, and least related to solar radiation, daily maximum and mean air temperature which accounted for 0, 47 and 67% of the variance, respectively. The quadratic and multiple regressions did not improve the fit. The equation relating RGR and minimum air temperature was:

$$RGR = 0.016\, T_m - 0.172$$

The standard error of estimate of slope and intercept were 0.0035 and 0.0196 respectively, residual standard deviation was 0.019 and correlation coefficient 0.87 significant at $P < 0.05$.

DISCUSSION

Early growth rate was strongly correlated with mean minimum temperature as found for other species, e.g. lucerne (Smoliak *et al.* 1972) and tropical grasses (Ivory and Whiteman 1978). Other temperature terms and solar radiation either alone or in combination were less important. The RGR values were determined for variable growing periods ranging from 18 to 40 days. This may have reduced precision in the strict comparison of RGR values and the regression equation. However, the effect would be minimal if RGR was approximately constant up to day 40, a circumstance indicated in studies with other tropical legumes (Wilson 1972). Also, the data derived from the 18–day growth periods at least spanned the range of temperatures experienced during all experiments.

Using the derived equation and the long-term mean monthly minimum temperatures (mmmt) at Brian Pastures, Gayndah, the estimated RGR of leucaena shoots in September (mmmt 11 °C) would average 0.01 g g^{-1} day^{-1}. However, the 14 percentile of mmmt was 5.8 °C (Anon. 1975), at which temperature there would be no growth giving a high likelihood of failure. In October (mmmt 15 °C), the estimated RGR would average 0.06 g g^{-1} day^{-1}, with little chance that temperatures would ever be too low for growth.

TABLE 1

Mean relative growth rates (RGR) of leucaena seedlings and average daily minimum, maximum and mean temperatures and solar radiation for nine sowings at 'Brian Pastures', Gayndah

Planting date	Average time to emergence	Average growing period	RGR of tops	Mean daily minimum temperature	Mean daily maximum temperature	Mean daily temperature	Solar Radiation
	(days)	(days)*	($g\ g^{-1}\ day^{-1}$)	(°C)	(°C)	(°C)	($Cal\ cm^{-2}\ day^{-1}$)
October 6, 1974	8	20	0.0502	13.3	27.2	20.3	492
September 24, 1975	10	18	0.0383	13.9	28.0	21.0	483
September 20, 1972	8	34	0.1124	16.2	29.6	22.9	NA**
November 12, 1974	10	18	0.1220	17.1	30.0	23.6	541
November 6, 1972	11	23	0.0861	17.3	28.7	23.0	565
October 10, 1972	9	40	0.1264	17.4	29.8	23.6	549
October 18, 1972	10	18	0.1432	18.3	29.2	23.8	435
November 9, 1975	10	38	0.1051	18.6	31.4	25.0	556
November 23, 1971	6	36	0.1387	18.9	31.4	25.2	553

* From seedling emergence to harvest.
**Data not available.

To minimise establishment failure due to temperature restrictions on growth, leucaena should not be sown in south-east Queensland until mean daily minimum air temperatures are likely to remain above about 15°C. October is the earliest month when this is likely to occur at Gayndah, and meterological records (Anon. 1975) show that a similar planting time may be used at Childers, Gympie and Ipswich. At cooler localities such at Gatton, Kingaroy and Monto, plantings should be delayed until November.

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ANIMAL PRODUCTION IN CENTRAL QUEENSLAND FROM THE AUTUMN-WINTER FORAGE CROPS: LABLAB, MOLOPO BUFFEL GRASS AND ZULU SORGHUM

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ABSTRACT

The liveweight gain of cattle grazing grass pastures in central Queensland declines in autumn as the quality of the pasture deteriorates. The value of autumn grazed forage crops Lablab purpureus *cvv. Highworth and Rongai, and hybrid forage sorghum Zulu (*Sorghum bicolor x S. sudanense*) in improving cattle weights was assessed in two experiments conducted near Theodore in central Queensland. The effect of combining varying proportions of buffel grass (*Cenchrus ciliaris *cv. Molopo) and Highworth areas for grazing was also compared.*

In two out of three years (1973–75), steers grazing lablab at 1.7 steers ha^{-1} gained 50–60 kg liveweight during 86 days grazing (March–June). When buffel pasture was combined with Highworth lablab areas in varying proportions, liveweight gains were directly related to the amount of Highworth available in the Highworth/buffel grass pasture but no significant increase resulted when Highworth exceeded 67%.

In the second experiment, comparing whole cropped areas of Highworth or Zulu, both crops averaged 574 g head^{-1} day^{-1} liveweight gain over 102 days.