Effects of sowing depth and time on the emergence of perennial subtropical grasses

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Perennial subtropical grasses are well adapted to large areas of Northern NSW and have a potential role in both livestock and crop production systems. The success of producers in establishing subtropical grasses has often been low, which adds considerably to the cost of establishment. Most subtropical grasses require high soil temperatures to germinate (Watt and Whalley, 1982) and are subsequently sown in the warmer months of the year when soil surface moisture is low and rainfall is often erratic. Establishment problems have large-ly been due to moisture stress in the initial emergence phase (Watt, 1974), and often the only recipe to success is good rainfall following sowing (Belloti *et al.*, 1991). While rainfall cannot be controlled, depth and the time of sowing can be manipulated to best meet the seedlings emergence and establishment requirements..

An experiment was conducted at Tamworth looking at the effect of sowing depth and sowing time on the emergence of five perennial subtropical grasses.

Method

Five subtropical grass species were used; Bambatsi panic (*Panicum coloratum* L. var. *Makarikariense* Goosens), Gayndah Buffel grass (*Cenchus ciliaris* L.), Inverell Purple Pigeon grass (*Setaria incrassata* Stapf), Premier Digit grass (*Digitaria eriantha*) and Katambora Rhodes grass (*Chloris gayana* Kunth). Twenty-five seeds of each species were sown into soil at three depths (surface, 15 mm and 30 mm) in small plastic trays (25 cm x 35 cm x 5 cm). The soil used was a UF6.31 red clay. The surface sown seeds had 1 mm of soil cover to prevent them from being blown away. After sowing the trays were placed in the ground. Soil moisture was kept at field capacity using misting sprays to supplement natural rainfall. Emerged seedling were counted 6 weeks after the trays were sown. The emergence results were adjusted to 100% germination.

Three replicates of each sowing depth were sown monthly commencing in September 1996 and continued until the first week of March 1997. Soil temperature was measured every 2 hours on the soil surface and at 20 mm using thermocouples connected to a field data logger.

The significance of species, depth and time of sowing and their interaction were analysed by analysis of variance.

Results and discussion

Soil temperature

Soil temperature recordings (Fig. 1.) indicated a general trend of increasing soil temperatures up to February, after which the soil temperatures declined. The lowest soil temperature recorded was 6.9°C recorded on the 12/11/96 at 7:00 am. The previous day the maximum soil temperature reached 41.4°C at 3:00 pm, and by 3:00 pm of the 12/11/96 the soil temperature was back up to a maximum of 40.5°C. This pattern of large variation in diurnal surface soil temperatures continued throughout November. Less diurnal variation was found at 20 mm depth.

The average emergence of all five grasses for all three sowing depths is presented in Fig 2. The graph shows that the highest emergence for all of the grasses was from a late December sowing ($P < 0.05$). These seedlings emerged during late December and January, coinciding with the peak in soil temperature in January. As the soil temperatures declined, so did emergence.

The germination percentage and vigour of subtropical grasses has been known for many years to be largely dependent on temperature (Toole *et al.*, 1956; Mayer and Poljakoff, 1963). Bambatsi panic,

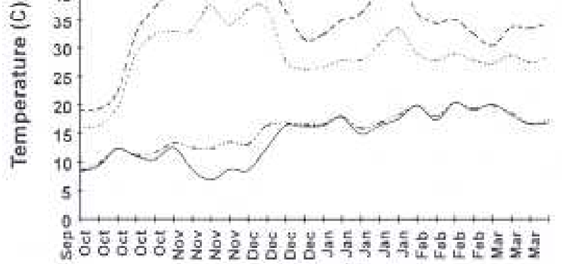

Figure 1: Soil temperature recordings on the surface and 20 mm depth from 20 September, 1996 to 20 March, 1997.

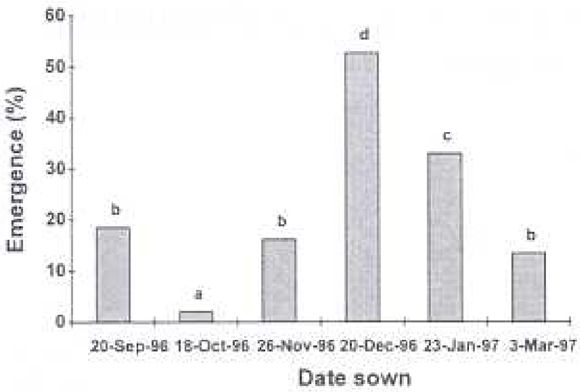

Figure 2: Average emergence of five subtropical grasses sown from September 1996 to March 1997. Columns sharing the same letter are not significantly different P<0.05.

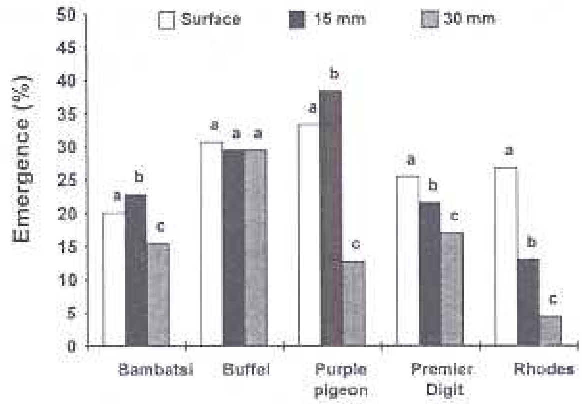

Figure 3: Average emergence of Five subtropical grasses when sown of the surface, 15 mm deep and 30 mm deep. Within species, columns sharing the same letter are not significantly different P<0.05.

Purple pigeon grass, Rhodes grass and Buffel grass have been shown to have optimum germination temperatures in the range of 20-35ºC (Watt and Whalley, 1982). For most of the North West slopes of NSW average 9:00 am soil temperatures will be achieved after the first week of November and are satisfied until the beginning of March.

The lowest emergence for all grasses was obtained from the October sowing (P<0.05). These seedlings germinated and emerged during the period of high diurnal temperature variation in November. The emergence of all grass species was badly affected by diurnal temperature variation. This effect was also evident in large areas of commercially sown grain sorghum, which emerged and established poorly in the Tamworth district in November 1996. Lodge (1981) also reported poor seedling emergence and survival of native grasses when sown in the spring, and suggested large temperature fluctuations as a possible cause, in what is normally regarded as the period of the year most conducive for plant growth.

Sowing depth

Sowing depth had a significant effect (P<0.05) on the emergence of all the grasses tested, with the exception of Buffel grass which was not found to be sensitive to the sowing depths used in this experiment. Bambatsi panic and Inverell Purple Pigeon grass emerged best (P<0.05) when sown at 15mm and emerged the poorest at 30 mm. Premier Digit grass and Katambora Rhodes grass both emerged best (P<0.05) when sown on the surface. Rhodes grass was particularly sensitive to sowing depth, with emergence of seed sown at 15 mm was approximately half (P<0.05) that of surface sowing across all months, while emergence from 30 mm deep was one sixth (P<0.05) that of surface sown seed for all months. Previous research (Leslie, 1965) has shown Rhodes grass to be very sensitive to excessive sowing depth. Surface sown seedlings of all species were more prone to desiccation and death after emergence than seeds sown at depth, even though the soil moisture was kept at field capacity.

Conclusions

The emergence of the subtropical grasses in this experiment can be improved by sowing at an appropriate depth and time of the year. Adequate soil moisture and temperature are essential to initiate germination. Sowing depth affects the soil temperature and moisture around the seed and the optimal depth differs between species.

Large fluctuations in diurnal soil temperatures appear to be another major factor affecting the germination and emergence of subtropical grasses. This experiment and other research indicates late spring appears to be the time of the year most susceptible to large diurnal temperature fluctuations. Less diurnal fluctuation occurs at a shallow depth than on the soil surface.

Achieving a successful emergence is only part of the story. Successful establishment of subtropical grass pastures can only come through good seedling emergence followed by favourable soil moisture for secondary root development. Good agronomic management of the seed bed before and after sowing including weed control, moisture conservation and adequate fertility are also needed for successful emergence and establishment of these grasses.

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