Tolerance of forage oat cultivars to high soil temperatures at planting

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Introduction

Forage varieties of cultivated oat (*Avena sativa* L.) are widely grown in sub-tropical areas of eastern Australia during the autumn and winter months, providing high quality forage for grazing animals. The recommended planting time for forage oats is from mid-March until the end of May during the southern hemisphere autumn. Due to changing weather patterns in recent years, farmers are planting forage oats up to two months earlier than recommended. Oat seed planted at this time is exposed to very high soil temperatures during germination and emergence, often resulting in low plant population and poor crop establishment. Little information is available on the ability of local cultivars to tolerate high soil temperatures at planting.

Methods

Twenty seeds of a range of commercial and experimental varieties were planted at 5cm depth in a sand/peat mix in sealed styrofoam containers and placed in a controlled environment chamber at constant temperatures of 15ºC, 30ºC, 32ºC and 35ºC. Each temperature treatment was maintained 18, 8, 7 and 6 days, respectively, so that each treatment was exposed to a similar number of heat units.

Germinated seedlings were then removed from the containers and the length of the coleoptile and mesocotyl of ten seedlings was measured for each variety.

A concurrent field experiment was also planted to validate the results from the laboratory experiment. Seed of a range of varieties was planted at 10 cm depth into a red clay soil at Toowoomba and exposed to ambient temperatures in mid-summer, and the number of emerged seedlings of each variety was counted after 14 days.

Discussion

Shoot elongation and germination (data not shown) of seedlings declined slowly as temperature increased from 15ºC to 30ºC. Both germination and shoot elongation declined rapidly as temperature exceeded 30ºC, although coleoptile length was more affected than mesocotyl length.

At 15ºC and 30ºC, there was significant variation between varieties for germination and shoot elongation. At 15ºC, the shoot elongation of the leading commercial cultivars Nugene, Volta and Taipan were not significantly different. However, shoot elongation of Volta seedlings at 30ºC was significantly greater (P=0.05) than Nugene and Taipan.

At 35ºC, there were no varietal differences in total shoot elongation, but there were significant differences in mesocotyl and coleoptile elongation.

Results from the field experiment (data not shown) were comparable to the laboratory experiment, but the seed source of each varieties was found to have a much greater effect on germination and emergence.

The threshold temperature for satisfactory germination and establishment in this experiment was between 30ºC and 35ºC. Selection for variation in tolerance to high temperatures should be possible using this procedure.

Results

Figure 1: Oat seedlings emerging from sand/peat mix in styrofoam box after temperature treatment *(left)* and measurement of coleoptile and mesocotyl of oat seedlings *(right)*.

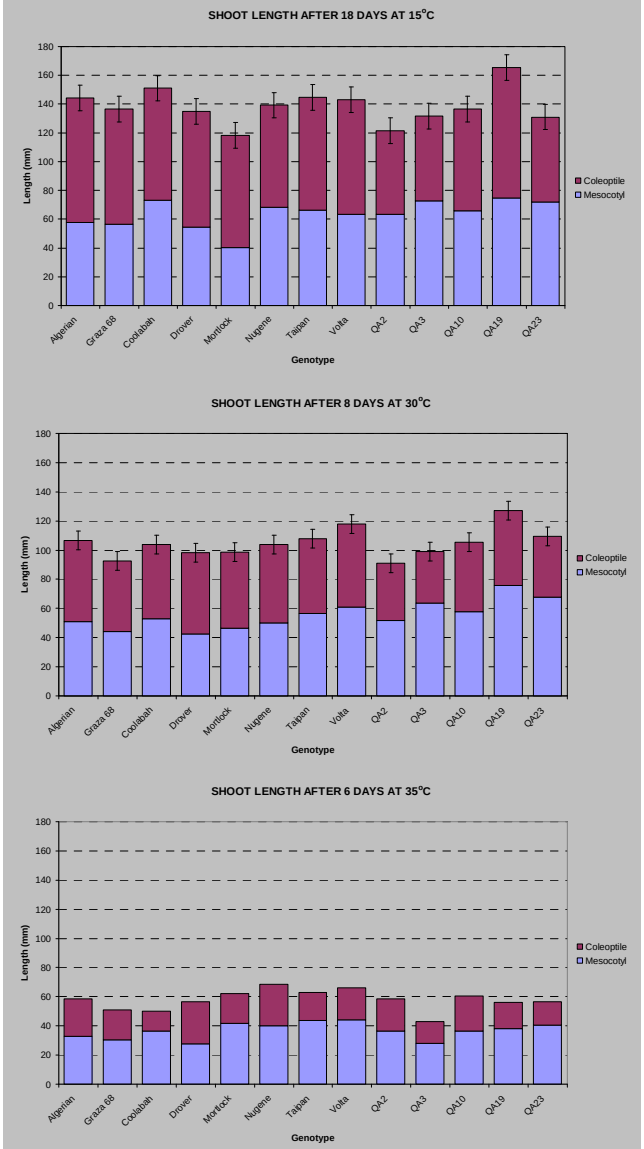

Figure 2: Length of coleoptile and mesocotyl of seedlings from 13 oat cultivars after 18 days at 15ºC *(top)*, after 8 days at 30ºC *(middle)* and after 6 days at 35ºC *(bottom)* in sealed styrofoam containers.

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