The effect of conventional cultivation and direct drilling on soil temperatures during the early growth of wheat

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Direct drilling of wheat in Australia is becoming increasingly popular due to a number of advantages when compared to the conventional system of a cultivated fallow. Direct drilled wheat however, often show reduced early growth, and sometimes this appears to be associated with reductions in grain yield. Many reasons have been proposed for this lack of early vigour and reduced yields. Hay (1) suggested that soil temperature was one of the major factors determining leaf extension rates. The aim of this paper is to report on effects of three tillage practices on soil temperature and on the early growth of wheat at Murrumbateman, N.S.W.

Methods

Replicated thermocouples were used to measure soil temperatures just under the soil surface and at depths of 1,5,10 and 30 cm in three tillage treatments. The treatments were conventional cultivation (CC) direct drilled/maximum disturbance after stubble burning ($DD_{(max)}$) and direct drilled/minimum disturbance while maintaining a straw mulch ($DD_{(min)}$). Wheat plants (var. Egret) were harvested at the 4 ? leaf stage of development.

Results and Discussion

Generally the soil temperatures of the conventionally cultivated treatment (CC) were warmer during the day and cooler during the night than the direct drilled treatments (DD). The insulation effect of the straw on the direct drilled minimum disturbance $DD_{(max)}$. caused less fluctuations of diurnal temperatures. The time delay with depth of a response to a heat flux at the soil surface was also apparent. For example on 4/5/82 the CC peak temperatures were delayed by 0.25, 1.75, 3.5 and 6.5 h at depths of 1,5,10 and 30 cm, respectively. Before sowing, soil temperatures in the conventionally cultivated treatment (CC) were on average 11.75, 7.5 and 3.75?C warmer in the middle of the day than the direct drilled treatment with straw additions ($CC_{(min)}$) at the sub-surface and at depths of 1 and 5 cm, respectively.

The soil Temperatures of the direct drilled treatment which had been burnt ($DD_{(max)}$) were also warmer during the day, than the direct drilled treatment with straw ($DD_{(min)}$), but were cooler than the conventionally cultivated treatment (CC) by 4, 2.5 and .5?C at the subsurface and at depths of 1 and 5 cm, respectively. At night the soil temperature patterns reversed and the conventionally cultivated treatment soil temperatures were cooler than the direct drilled treatments. Over 4-5/5/82, before sowing, treatment CC soil temperatures at 0600 hours were 8, 7.5, 3.5 and 2.0?C cooler than treatment $DD_{(min)}$ soil temperature at the sub-surface and at depths of 1, 5 and 10 cm, respectively. As before treatment $DD_{(max)}$) soil temperatures were between those of treatments CC and $DD_{(min)}$). Apparently the burnt and unburnt plant residues on the soil surface of treatment $DD_{(min)}$) were sufficient to reduce the heat flux across the soil surface. These temperature patterns persisted after sowing throughout the 1982 wheat growing season.

The average plant dry weight of the conventional cultivation treatment (212 mg) was greater than both the direct drill treatments and plant dry weight of ($DD_{(max)}$) (152 mg) was greater than dry weight per plant of wheat sown in ($DD_{(max)}$) with straw (136 mg) in 1982. This suggests that the improved early vigour of wheat sown by conventional cultivation practices, could be due to the associated warmer daytime soil temperature and the cooler night soil temperature than those found when wheat was directly drilled into the soil.

1. Hay, R.K.M. 1977. J. of Soil Sci. 28, 403-9.