Stubble retention effects on soil water storage and yield

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The red brown earth soils of the eastern margin of the Western Australian wheatbelt cover about 1,000,000 ha and are used almost exclusively for the production of wheat and barley. Significant yield gains have been obtained on these soils fro direct drilling, through improved structural stability which increases rainfall infiltration (1). As yields are seldom more than 1.5 $t.ha^{-1}$, resulting stubble levels are not likely to have any more than marginal effects on evaporation loss (2); yet stubble retention is complementary to direct drilling in affording surf protection from raindrop impact, which causes surface sealing, reduced rainfall infiltration and runoff erosion. To establish effects of low levels of stubble soil evaporation, rainfall infiltration and yields, several experiments were initiated on red brown earth soils at Merredin comparing standing stubble with 0, 1, 2, 4 and 8 $t.ha^{-1}$ of applied stubble.

Methods

Soil moisture data were obtained gravimetrically or with a neutron moisture mete at weekly or fortnightly intervals. Dry matter, straw residue level, yield and s structure stability data were obtained where appropriate.

Results and discussion

Summer Water Storage:

Infiltration from 50 mm of sprinkler irrigation in March 1985 was improved by the presence of stubble and was greater with increasing amounts of applied stubble. However, evaporative losses were higher with increasing amounts of stubble and were as high or higher from straw covered surfaces as from bare soil. Similar results have been reported from a combined heat-water transport model (3) and discussed in terms of residue covers being more effective in reduce evaporative losses in climates with frequent rainfall additions and decreasingly) effective where there were extended periods without summer rain.

Winter Water Storage:

In cultivated but uncropped experiment water storage fl rainfall was monitored from July to December 1985. Data showed that stubble increased rainfall infiltration but stubble level interacted with rainfall intensity. During periods of high rainfall intensity, redistribution was more rapid with increasing stubble level. Conversely, during periods of light shower greater evaporation occurred with increasing stubble level, probably because more water was trapped within the straw so that thermal gradients developed within it (3). Significantly therefore, low rates of stubble were almost as effective as high rates, with an average 20 mm increase in water storage over the nil stubble treatment and an 18% reduction in evaporative loss.

Yields:

Rainfall distribution had a significant effect on yield responses. In 1984, after heavy March-May rains and low growing season rainfall, yields were (190 $kg\ ha^{-1}$) higher with the 2 $t.ha^{-1}$ applied stubble than nil stubble treatment. Standing stubble and 2 $t.ha^{-1}$ of applied stubble gave a 34% (144 $kg.ha^{-1}$) yield increase over nil stubble yield of 424 $kg.ha^{-1}$ in 1985 when pre-season rainfall was negligible and growing season rainfall to mid September significantly below average. However, a 7% (130 $kg.ha^{-1}$) response for these treatments in 1986 was not significantly different from nil stubble yield of 19, $kg.ha^{-1}$, as unusually heavy June - July rainfall filled the profile to 1.5 m compared to the normal 1.0 m. Five year means from

another experiment show a 1: (130 kg.ha:1) yield gain from direct-drilling which is further increased to 20% (194 kg.ha) with stubble retention.

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