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Summer fallow management and its effect on crop yield

Ketema Tilahun Zeleke

School of Agricultural and Wine Sciences - Charles Sturt University, Australia

In arid and semiarid regions, the water stored in the soil from the off-season/fallow period rainfall can be a substantial component crop water supply. As a result, fallow management using stubble cover and/or weed control is important. However, the effect of stored soil water on crop yield can be affected by different factors. A field experiment and computer simulation study using agricultural production systems simulator (APSIM) was conducted for two seasons (2015 and 2016) in the semi-arid environment of south-eastern Australia. Four treatments were established: weed free – no stubble, weedy – no stubble, weed free – stubble covered, weedy – stubble covered. The presence or absence of stubble did not make significant difference on soil water content and nitrogen level. However, weed growth during the summer period significantly affected the soil water storage. By the time of winter crop sowing, the plant available water (PAW) was depleted by 18 mm in weed free – stubble covered treatment, 23 mm in weed free – stubble free treatments, 52 mm in the weedy – stubble covered treatment, and 64 mm in weedy – stubble free treatment. The weedy (39 kg ha⁻¹) and weed free (98 kg ha⁻¹) treatments differed significantly in the amount of soil mineral nitrogen. Long term simulation showed that there was 88% probability of accumulating 140 mm PAW by the time of sowing when there was no weed, compared with only 13% probability when weed was present. While soil water and nitrogen storage may vary with soil type, rainfall amount, rainfall distribution, and weed pressure, fallow weeds must be controlled to ensure accumulation of fallow soil water and nitrogen for a subsequent crop. To see the effect of different stored soil water and nitrogen on crop yield, a field experiment was conducted using the above created scenarios. The initial soil water content did not make significant difference in crop yield as there was high amount of rainfall during the 2016 crop growing season. High initial water even led to yield decrease, due to nitrogen leaching beyond the crop root zone. However, stored nitrogen level made significant difference in crop yield. Simulation results also showed that as the amount of in-season rainfall increases, the yield benefit from stored soil water decreases.

kzeleke@csu.edu.au