

# THE EFFECT OF CROP SEQUENCE AND TILLAGE PRACTICE ON SOIL LOSS AND RUNOFF IN A SEMI-ARID ENVIRONMENT

C. Carroll, M. Halpin and P. Burger

Department of Primary Industries, Locked Mailbag 6, Emerald, Qld 4720

Between 1982 and 1986 the cropping area in the central highlands of central Queensland increased from 250,000 to 512,000 ha. The rapid expansion of cropping led to the establishment of a project that studied the effect of crop type, crop sequence and tillage practice on soil loss and runoff.

## MATERIALS AND METHODS

The study was located at Capella in Central Queensland. Measurements of runoff and soil loss were made at the outlet of nine agricultural catchments (approximately 13 ha in size), using a 2.4 m Parshall flume and pump sediment sampler. Wheat, sorghum and sunflower were grown in the catchments, under three crop sequences. Each crop sequence consisted of zero, reduced and conventional tillage. Initially monoculture cropping was used in the first phase of the study (1982 - 1985) after which *opportunity cropping* was used (1986-1993). The soil type at the site is classified as Mollic Torrt in the Vertisol soil order.

## RESULTS AND DISCUSSION

Both crop sequence and tillage practice had a significant effect on average annual soil loss ( $P < 0.05$ ). Crop sequence 2, where five crops of sunflower and only two crops of wheat were grown, had significantly higher soil loss than sequence 1 and 3, where four and five crops of wheat were respectively grown over the 12 year study. Zero tillage had significantly less soil loss than the conventional tillage practice in the three crop sequences. Crop sequence 3 (where wheat was predominantly grown) had significantly less runoff than sequence 1 and 2. A higher soil water deficit and greater stubble cover leading into the region's summer rainstorm period, are two reasons for less runoff and soil loss when wheat is grown in a rotation. In contrast, sunflowers produce the highest risk of soil erosion and runoff, since the crop produces low stubble cover, and the fallow and seedbed preparation coincide with the summer rainstorm period. Soil erosion is reduced when sunflowers are rotated with wheat (a high stubble producing crop), particularly when zero tillage is used. The largest annual soil loss and runoff (30 t/ha, 284 mm) occurred in 1983, when there was 982 mm annual rainfall. Three rainstorms caused 50% of the annual erosion and occurred when there was low cover and followed an 18 month drought. In contrast, there was just 3 t/ha soil loss where sorghum and wheat were zero tilled in 1983.

On average, there were three tillage operations during a conventional fallow, and two tillage and less than one herbicide operation during a reduced tillage fallow. Overall, the reduced tillage system had the highest gross margin. Zero tillage had a lower gross margin than reduced tillage because of increased cost of herbicide. However, when double cropping, zero and reduced tillage gross margins were often similar. Zero tillage has the added benefit that weeds are controlled and a crop sown with minimum soil preparation and soil disturbance, thereby increasing the potential to take double cropping opportunities. In the study, due to less soil disturbance, earthworm populations were generally higher in the zero tillage, and lower in the conventional tillage practice.