

Effects of irrigation duration on seed yield and economy of sunflowers

F.M. Melhuish, W.A. Muirhead and R.J.G. White

CSIRO, Centre for Irrigation Research, Griffith, NSW 2680

Nitrogen fertiliser applied to crops is subject to loss mainly by ammonia volatilisation, adsorption, immobilisation in organic matter, leaching and denitrification. Recovery of N fertiliser in a single crop is unlikely to be greater than 50-70% and is often far lower. In order to evaluate techniques for maximising N-fertiliser use efficiency the effects of a range of realistic conditions need to be studied in the field. Length of irrigation duration (ponding) in flood irrigation "systems" is an important variable which could influence N leaching and denitrification losses in particular. The effect of long ponding times on sunflower growth, yield and fate of N fertiliser was studied in the field experiments reported here.

Methods

Ammonium sulphate at 50 kg N ha^{-1} was applied to 5 treatments (4 replicates) in which the irrigation water was ponded for periods of up to 48 hours at each irrigation. A control treatment with no fertiliser and no ponding was included in the experiments. For studying the fate of N-labelled fertiliser was applied to cylindrical microplots 33 cm in diameter and 45 cm deep. The experiments were carried out in 2 seasons, with 50% emergence on 27-1-81 (cv. Hysun 30) and 28-11-81 (cv. Sunking). The experiments were carried out "on the flat" to permit soil sampling before and immediately after each irrigation to monitor volumetric moisture and changes in mineral N species (RC1 extracts) with time.

Results and Discussion

In both experiments the seed yield declined with extended periods of ponding at each irrigation (Fig. 1). The decline in Experiment 1 was about $7 \text{ kg seed ha}^{-1}$ of ponding and $38 \text{ kg seed ha}^{-1} \text{ h}^{-1}$ in Experiment 2. Because of the late sowing and early rain only 2 irrigations were applied in Experiment 1. Five irrigations were applied in Experiment 2. The yield of the control treatment with no fertiliser was similar to that of the 48 h ponding treatment in Experiment 1 and of the 24 h ponding treatment in the Experiment 2. Soil water extraction profiles across the various treatments in Experiment 2 demonstrated that root function, as far as water uptake reflects this, was little affected by prolonged irrigations. Temporal changes in soil Mineral nitrogen, together with N soil and plant analyses discriminated between direct effects due to soil anaerobiosis or to promotion of leaching/ denitrification leading to crop N "starvation". Denitrification is suggested as the major constraint. Several common flood irrigation practices lead to ponding up to 48 h and the application of water-run urea during irrigation is suggested as one practical means of minimising effects on N availability.

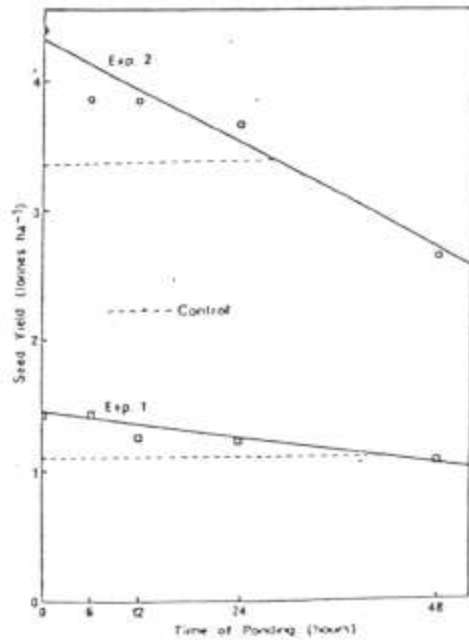


Fig. 1. Effect of ponding on yield of sunflower