The role of drought avoidance mechanisms in tolerance to *Heterodera avenae* was examined in two oat cultivars differing in tolerance to this nematode. Withholding water for 8 days in 22-day-old nematode-infested plants increased the rate of leaf dehydration in the nematode tolerant, compared to the intolerant cultivar. This was attributed to greater root growth inhibition in the intolerant cultivar, resulting in a slower rate of dehydration despite higher stomatal conductance in the infested intolerant cultivar. The results suggest that mechanisms that alleviate water deficit stress could play a role in determining tolerance of cereals to *H. avenae* but only under well-defined conditions.

**Keywords:** Roots, stomatal conductance, water stress, water potential.

The cereal root nematode, *Heterodera avenae* Wollenweber, seriously affects yields of cereal crops in Australia (Brown, 1984) by impairing root growth (Simon & Rovira, 1982). Because of root stunting, parasitized plants may suffer the effects of water stress more frequently and for longer than healthy plants. Several studies have associated increased nematode tolerance with drought avoidance mechanisms, that is, properties of the plant that either enhance water acquisition (Evans et al., 1977) or reduce water loss (Evans & Franco, 1979). For example, it has been suggested that plants with large root systems or reduced sensitivity to root stunting may be more tolerant to nematode infection (Trudgill & Cotes, 1983; Price et al., 1983). Reduced water loss in tolerant plants has been found by some to be facilitated by earlier stomatal closure at the onset of water deficit stress (Evans, 1982; Fatemy et al., 1985). The importance of these mechanisms in nematode tolerance will depend upon the extent to which normal water relations of the plant are disturbed by nematodes, as well as on the availability of moisture following nematode invasion. If there is ample soil moisture, drought avoidance mechanisms may play no part in nematode tolerance but they may become increasingly relevant as the soil dries.

The purpose of this study was to determine the extent to which *H. avenae* affects the water relations of a tolerant and an intolerant oat cultivar under well-watered and water-deficit stress conditions.
MATERIALS AND METHODS

Two oat cultivars, New Zealand Cape (NZC) which is tolerant and resistant and Sual which is intolerant and resistant to \( H. avenae \) (Barr & Dube, 1985; Volkmar, 1990) were used. Seeds of each cultivar were pre-germinated until three seminal roots had emerged, and the seedlings were then transplanted into 2.7 x 13.0 cm plastic tubes containing John Innes soil mix composed of equal parts steam-sterilized coarse sand and medium loam amended with fertilizer \((g\cdot m^{-3})\) : blood meal, 600; \( K_2SO_4 \); \( KH_2PO_4 \), 550), without peat. Plants were grown in a controlled environment cabinet maintained at 20°C day and 15°C night temperatures with a 16 h photoperiod. Light was supplied by a combination of high pressure sodium (60 W) lamps, "Cool White" fluorescent tubes, and incandescent bulbs, to provide a total irradiance of 590 \( \mu E\cdot m^{-2}\cdot s^{-1} \) at canopy level.

The nematode inoculum used in this study was obtained from cysts collected from a stubbled barley field in South Australia. \( H. avenae \) cysts were separated from root material by wet-sieving and decanting and incubated in petri dishes on a screen in shallow water at 5°C. Juveniles were collected daily and incubated at 5°C in shallow water until required.

Seedlings were inoculated with 250 or 1000 second stage \( H. avenae \) juveniles (J2 s) after 3 d incubation 15 10°C. Six days later, seedlings were selected for uniformity and transplanted, soil intact, to plastic tubes (5.4 cm ID x 26 cm) containing autoclaved modified inert solid medium (trade name: Oildry, U.S. distributor: Eagle Picher Minerals, Inc., Reno, Nevada). The tubes were closed at the bottom with a plastic screen (1.0 mm) to allow drainage. Quarter-strength Hoagland's solution (Hoagland & Arnon, 1950) was added until the Oildry was well-wetted and the solution drained freely from the bottom. This was done at the time of transplanting and every second day for the first 12 d. After 12 d, half of the control and inoculated plants continued to receive nutrient solution while the other half received none.

Plants were arranged in a randomized complete block design. Treatments consisted of two cultivars, three inoculum levels, two levels of soil moisture and five sample dates with eight replications per sample date.

Measurements of water potential of the penultimate leaf, root length and number of J2 s in the roots were made on plants every 2 d during the next 8 d. Leaf water potential was measured using a Spanner thermocouple psychrometer (Barrs, 1968). Pre-dawn measurements of stomatal conductance were taken during the 8 d treatment interval using a diffusive resistance porometer, model Mark III (Delta Devices). Roots were cut from the stems and washed on a 250 \( \mu m \) screen under a gentle stream of water. They were then stored in lactophenol containing 0.1% cotton blue (Hooper, 1970) for up to 3 wk before measuring root length using a line-intersect method (Newman, 1966). J2 s were counted using a dissecting microscope.