Waterlogging of wheat in the field II. root growth and crop yield

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Inadequate supplies of oxygen have been identified as the primary cause of reduced crop growth in waterlogged soil(1). Yield reductions ranging from 39-100% have been reported for cereals and oilseeds subjected to different levels of waterlogging in the field(2) and for cereals in pot experiments(3). This paper reports initial findings of the effect of controlled waterlogging on the root growth and yield of wheat.

Methods

Wheat (c.v. Gamenya) was sown (9/6/83) in four special plots as described in the preceding paper; plants were thinned to 200 plants/m 20 days later. Macronutrients (N,73; P,89; K,149 kg/ha) were applied over three applications throughout the season whilst micronutrients (Cu,1180; Zn,540; Mo,72 g/ha) were applied at sowing. Artificial waterlogging to the soil surface (A.W.) was imposed for 9 days (13/7 to 22/7) and 11 days (4/8 to 15/8) on 2 plots; and 2 plots were drained (D) for the duration of the trial. Two plots subject to natural waterlogging (N.W.) (11 weeks) were located adjacent to the 4 main plots. Soil water and oxygen were monitored in all plots. Root growth was measured by means of soil corers at the end of the (A.W.) treatment (15/8) in all 6 plots. Plots were harvested on 5/12.

Results and Discussion

O_2 concentrations in the soil water responded rapidly to drainage and waterlogging (see previous paper). Root penetration was reduced in both the A.W. and N.W. plots : on 10/8 the proportion of the root system in the top 5cm for the D, A.W. and N.W. plots (7 weeks waterlogging at this date) was 48, 59 and 85% respectively. Waterlogging also affected the nodal/seminal root ratio : on 15/8 nearly all roots of N.W. plants were nodal. Nodal roots have been shown to have excellent aerenchyma formation(1).

TABLE 1 Effect of waterlogging shoot and grain yield

YIELD PARAMETER	DRAINED	ARTIFICIALLY WATERLOGGED (20 DAYS)	NATURALLY WATERLOGGED (11 WEEKS)
Shoot Weight			
tonne ha^{-1}	4.32[a]	4.42[a]	1.36[b]
g $plant^{-1}$	2.15[a]	2.33[a]	0.93[b]
Grain Weight			
tonne ha^{-1}	1.77[a]	1.74[a]	0.42[b]
g $plant^{-1}$	0.88[a]	0.92[a]	0.29[b]

Values with the same letter in each row not significantly (P 0.05) different.

Drainage increased the yield of Gamenya 3-fold compared with the yield on the N.W. plot (Table 1). Despite the effect of 20 days waterlogging on root growth during early tillering there was no adverse effect on yield at the end of the season.

References

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