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RESEARCH ARTICLE

GENOTYPIC DEPENDENCE OF WHEAT SPECIES IN NITROGEN UPTAKE DETERMINES BY ROOT MORPHOLOGY AT MATURITY

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ABSTRACT

The root system is essential for taking up nutrients while providing anchorage to the plant. The controlled environment experiment was conducted to study root morphological traits, plant growth, yield and nitrogen (N) uptake in different wheat species. Seven genotypes including cultivated emmer (*Triticum dicoccum*), spelt (*T. spelta* L.) and modern bread wheat (*T. aestivum*) under three N levels were examined. A split-plot design was used in the experiment where the main plot factor was N levels and the sub-plot factor was genotypes and replicated three times. Root samples at five depth layers were scanned and analysed using *WinRHIZO* software at anthesis and maturity. Total root length, root volume, root biomass, root diameter, root length density, rooting depth and root N uptake efficiency were recorded. Plant N uptake, N uptake efficiency, N utilisation efficiency and N use efficiency were calculated at maturity (excluding N in roots). Neither interaction effect between main factors nor N level were significant for all measured root traits except N uptake efficiency of roots. Similar results were observed for growth and yield traits together with plant N uptake, N uptake efficiency, N utilisation efficiency and N use efficiency. All measured parameters were significantly different among genotypes. Spelt genotypes recorded the highest total root length, root volume, root biomass and root length density at all depth layers while emmer genotypes recorded the greatest root N uptake efficiency. Plant N uptake was significantly different between genotypes where all spelt genotypes had high plant N uptake followed by bread wheat and emmer. Plant N uptake of the genotypes had a very strong positive correlation with total root length, root volume, root biomass and rooting depth of the genotypes. Therefore, it could be concluded that the high plant N uptake of spelt may be due to the robust and vigorous growth of root systems.

Keywords: N uptake, maturity, root traits, spelt genotypes, wheat species

INTRODUCTION

Wheat is the first cereal known to be domesticated about ten thousand years ago. For the past eight thousand years, wheat served as a staple food for people living in Europe, West Asia and North Africa (Curtis 2002). About 90% of cereal demand all over the world is supplied by wheat, rice and maize (Braun *et al.* 2010). Wheat provides 35 to 60% of the daily calories for people in North Africa, Central and West Asia. Demand for wheat is expected to increase 60% by 2050 while climate change is likely to depress yield (Easterling *et al.* 2007; Hubert *et al.* 2010). It is predicted that, to fulfil the demand, annual global wheat production should be increased from 716 million tonnes to 840 million tonnes by 2050 of which more than 70% will be consumed by people living in developing countries. However, at

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Author contribution
KMCF conceptualized and designed the experiment. KMCF and CW performed the experiment. KMCF analyzed the data. KMCF, CW and DLS wrote the paper with input from all authors. All authors discussed the results and commented on the manuscript.

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