Plant population on the dynamics of rooting in sunflower

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Introduction

The management of crop population is frequently used to control the seasonal pattern of crop water use and in this the development of the root system plays an important role. The objective of the study reported here was to characterize the development of the root system of sunflower in response to population density.

Methods

Two experiments involving two cultivars in populations ranging from 2.0 to 5.1 plants m⁻² were carried out on a coarse loamy soil (USDA Taxonomy, Typic Hapludoll). The crops grew without water shortage and without physical restriction to root exploration to reach a depth of 200 cm. Trenches were used (1) to assess root density (Rv, cm cm⁻³) below the stem and in the centre of the inter-row space. Also measured were: root depth (D90) defined as the depth containing 90% of roots below 20 cm, root length per plant (RLp, km), root length per unit crop area (RL, km m-2), and the ratio of the root length/leaf area index (RL/LAI (m2 km-1).

In an attempt to standardize the effect of cultivar and population density, leaf area per plant (A) and D90 were divided by the corresponding values of A and D90 at anthesis to give D90r and Ar respectively.

Results and Discussion

Season and cultivar effected D90 but there was no response to population density. A single relationship (D90r=0.96*(1-exp(-8.26*Ar), R²=0.96) fitted all data suggesting the dominance of allometric relationships of plant morphology over responses to environment. This relationship provides a prediction of the dynamics of the development of root depth from the easily measured parameters, D90 and A at anthesis.

Plants grown at the highest populations had significantly (P<0.05) higher Rv in the 20-200 cm layer during pre-anthesis and significantly lower Rv in the same layer post-anthesis. Per plant, the growth of root length and leaf area were substantially modified by population density, ie RLp and A at anthesis were 50% lower at high than at low population. Thus RL and LAI, and hence RL/LAI were unchanged by population although the densest crop grew faster early in the crop cycle.

Limited sensitivity of rooting depth to plant density, and compensation in leaf area and root length may help to explain the consistency in seasonal patterns of water use of sunflower.

30. Bohm, W., 1979 Methods of studying root systems. Ecol. Studies 33. Springer-Verlag, Berlin.